SIGNALS

JOURNAL OF THE ARMY SIGNAL ASSOCIATION • DEDICATED TO MILITARY PREPAREDNESS

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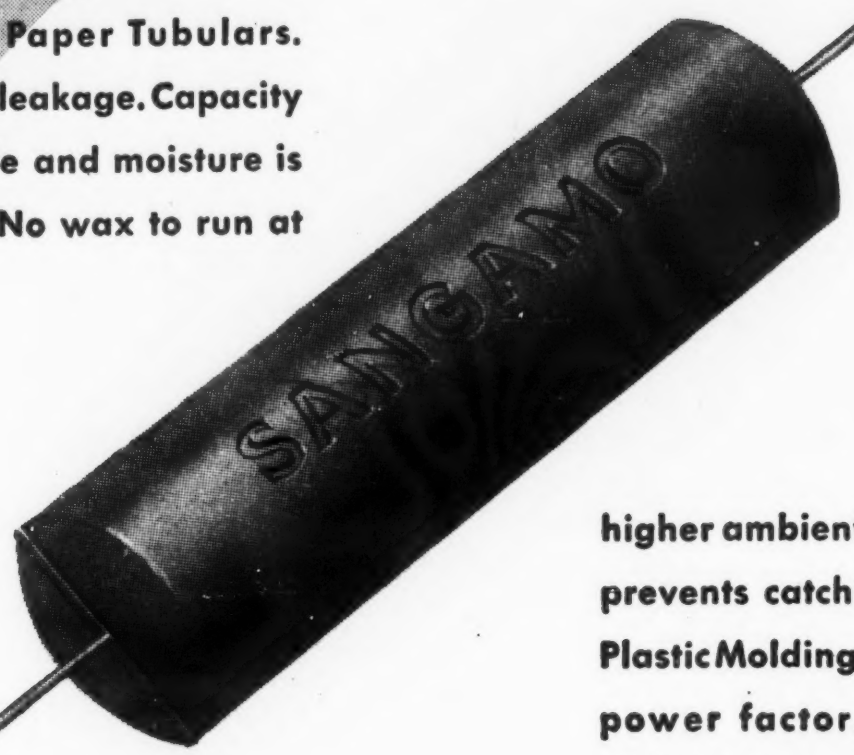

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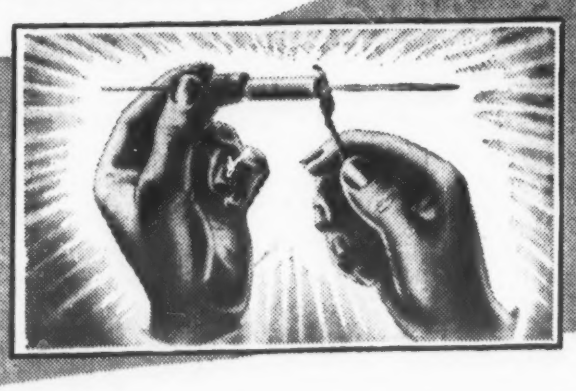

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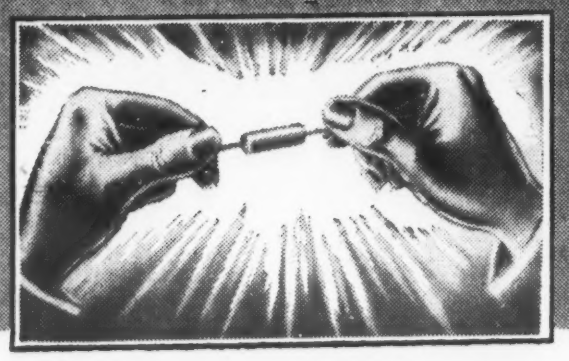

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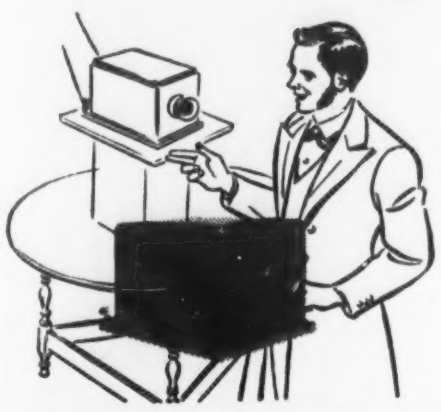
Why this team sets the pace in Microphone Development



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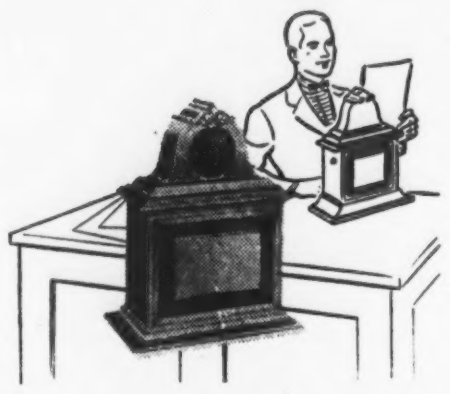

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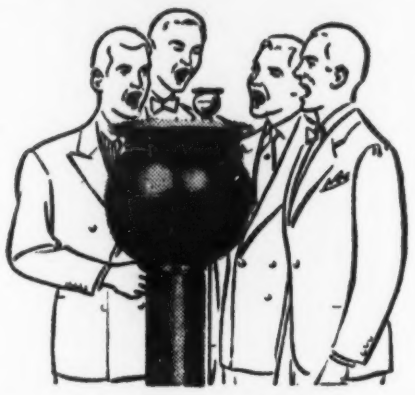

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1936: Directional with slide-on baffle, non-directional without it, the Salt Shaker gave highest quality pick-up at low cost. Widely used in studios and remotes as well as in high quality sound distribution.

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Distributed by GRAYBAR — OFFICES IN 95 PRINCIPAL CITIES

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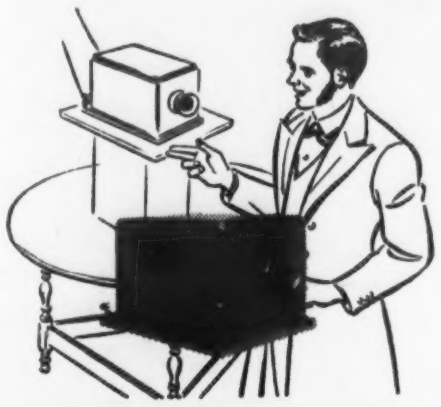
Why this team sets the pace in Microphone Development



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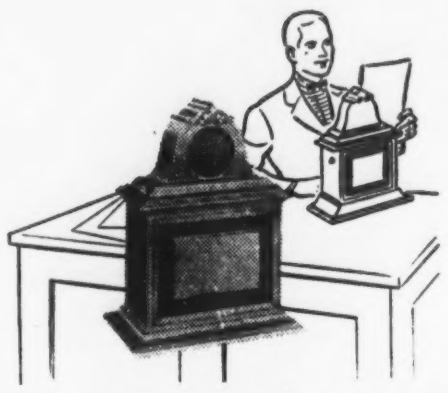

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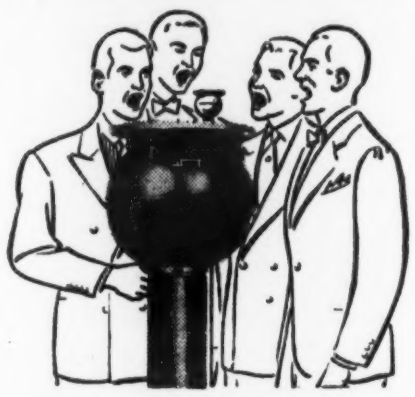

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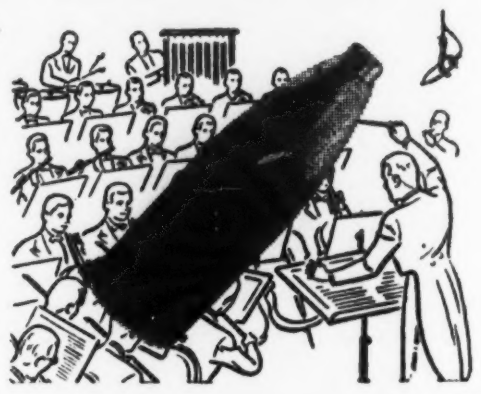

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Sgt. William A. Avery of Hollywood and his Number One Boy, Mamipalava. Port Moresby, New Guinea. February 1944.

APS cameraman Harold Hoffman was killed in action at Samar in the Philippines—1944.

PRODUCER: SIGNAL CORPS

By James E. Gibson Major, Signal Corps Reserve

CAPTAIN HERMAN WALL lay on a stretcher in an LST a few hundred yards from Omaha Beach. He was suffering from shock and loss of blood. His left leg was gone—blown to bits by a German mine. An Army surgeon was working desperately to save his life.

"I've got a secret package," whispered Wall, "pictures . . . important . . ."

He needed rest and quiet. The surgeon tried to calm him. "Look, Doc," he said earnestly, "these pictures gotta get to headquarters. They're countin' on 'em. Call them up, please . . . now."

When the LST reached England the call was made and a special plane was sent to pick up the "secret package"—the first pictures of the Normandy landings. Captain Wall, knowing the film was on its way, yielded to treatment, rest and eventual recovery.

Ingenious permanent Jeep-mount enabled cameramen to cover action at Anzio, Italy.

Of 1400 Signal Corps cameramen on the Western Front in Europe, 32 were killed in action and more than a hundred were wounded. When pictures failed to get through more often than not the cameraman had been forced to drop his equipment and fight with the Infantry, like cameraman Robert Main who won the Silver Star in the Pacific. His official report read, "wish we had coverage of this, but you can't throw grenades and take pictures too."

Millions of feet of motion picture film and thousands of still pictures were taken by Signal Corps photographers during World War II. The whole pattern of our victories in Europe and the Pacific is recorded on celluloid. At the Signal Corps Photographic Center in New York, under the supervision of the Army Pictorial Service, motion picture coverage has been and is being utilized in the preparation of newsreels, historical chronologies, training films and many special productions. The thousands of still photographs are filed in the Still Picture Branch of the Army Pictorial Service in the Pentagon. Many of these pictures have been published in newspapers and magazines with the credit line: "U. S. Army Signal Corps."

In the Beginning

But why "Signal Corps"? There is no direct relationship between photography and signal communications. Why not Ordnance or Engineers? Did you ever hear of a Frenchman named DeGuerre? He's the man who made the tin-type (Daguerrotype) popular, and is given credit for inventing photography in 1839. By the time the Civil War began the knowledge of photography had become rather widespread, and a civilian named Mathew Brady got permission from the War Department to take pictures of military activities at his own expense. The War Department purchased some 6.000 negatives of this famous collection shortly after the war and filed them in the War Department Library under the supervision of the the Chief Signal Officer. In 1881, Lt. Adolphus W. Greeley, later Chief Signal Officer, assigned to an enlisted man the job of taking pictures on his Arctic expedition. When he returned, the Signal Corps established a photographic laboratory at what is now Fort Myer, Virginia and began accepting photographic assignments from other branches of the Army. It was in 1909 that Orville Wright demonstrated a model of his aeroplane to the Army at Fort Myer, and a Signal Corps cameraman recorded the event on motion picture film. That's how the Signal Corps got into the film business—unofficially.

Photography achieved an offi-

Chief of the Motion Picture Production Section of the Army Pictorial Service, James E. Gibson is also a Major in the Signal Reserve. He received an AB from Duke University in 1934 and almost immediately entered the Government service, working with motion pictures. When called to active duty with the Signal Corps early in 1942, Gibson was placed in charge of film strip production. Later, as Visual Aids Officer for the Director of Military Training, Army Service Forces, he "saw action" on battlefronts all over the world—in the projection rooms of the Pentagon and at the Signal Corps' motion picture studios in Long Island City.

cial status in the Army only after the United States entered World War I. On August 10, 1917 a Photographic Division was established in the Office of the Chief Signal Officer to fulfill all photographic requirements of the Army. When the Army Air Forces, which had originally been a subdivision of the Signal Corps, became a separate branch in July 1918, it took with it all aerial photographic activities. Since then the Signal Corps has been concerned solely with ground photography.

The First War

During World War I the major effort of the new Photographic Division was directed toward recording a pictorial history of the war—both motion and still. Oversea photography was developed at the AEF laboratory in Paris until 1919, when the Signal Corps Photographic Laboratory was constructed on the grounds of the Army War College in Washington. There was also a demand for films to be used for training new recruits. This demand was partially satisfied by contracting with commercial concerns for the production of sixty-two films. Special films were made in conjunction with the Committee on Public Information for distribution to the American public. Such pictures as *Pershing's Crusaders, America's Answer* and *From Forest To France* were the morale builders of the day.

During the years of retrenchment following the end of World War I the Army Pictorial Service devoted its limited personnel and facilities to editing the pictorial record of the war, maintaining a small publicity service, operating Corps Area laboratories, and producing a few training films. By 1937, however, the demand for training films had forced the Signal Corps to establish a Training Film Production Laboratory at Fort Monmouth, New Jersey. In 1940 a similar laboratory was set up at Wright Field, Dayton, Ohio to handle Army Air Force requirements.

Expansion

When entry of the United States into World War II made it necessary for the APS to expand its facilities, the old Paramount Studios in Long Island City, N. Y. were purchased. In April 1942 the Laboratory and the Photographic School were moved from Fort Monmouth to the Signal Corps Photographic Center, the name given the Long Island installation. In October of that year the Wright Field installation was transferred to the Army Air Forces.

With the establishment of the Signal Corps Photographic Center the Army Pictorial Service became a major film producer, even by Hollywood standards. Writers, cameramen, directors, technicians and administrative personnel came to the Center from the industry through the Reserve Corps, direct commissions or recruitment by Selective Service. Many others with photographic backgrounds were trained for special jobs. Throughout this organizational period the Research Council of the Academy of Motion Picture Arts and Sciences cooperated with the War Department and aided in the placing of contracts for the production of training films with Hollywood film companies. In the latter part of 1942 the Western Division of the Signal Corps Photographic Center was established in Hollywood to serve as the contracting agency with West Coast producers. This Division continued to function until November 1945. Meanwhile still picture activities remained at the Signal Corps Photographic Laboratory on the grounds of the Army War College until the Fall of 1943, when new and larger quarters were provided in the Pentagon.

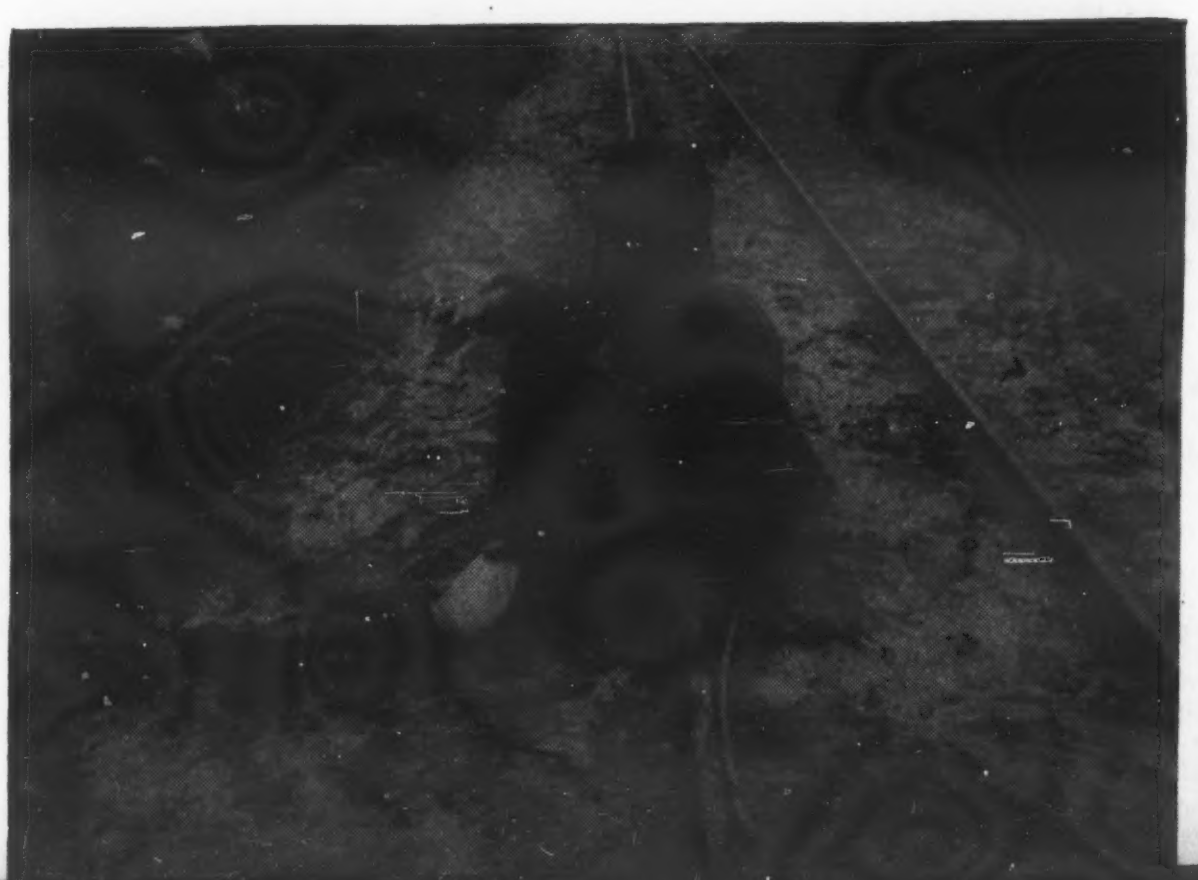
Pictorial History

Again during World War II a major mission of the Army Pictorial Service was the film history of the war—in both still and motion pictures. But there were other missions—training films, morale films, industrial incentive films, documentary films, and probably most important of all in oversea areas, entertainment films. To accomplish these missions required a large number of production personnel and milions of dollars in operating costs. Many individuals were concerned with the distribution of films, projection equipment, spare parts. Others were assigned to the development of new and better types of cameras and projectors.

The largest percentage of Army Pictorial personnel in the United States was devoted to the production of training films. During World War II and the emergency period immediately preceding it, the combined facilities of the Army Pictorial Service and the motion picture industry produced over 2,000 training films and almost an equal number of film strips. These training aids were requested by the various arms and services and used in the training of military personnel throughout the Army. They were distributed through a film library system serving all military posts and installations both in the United States and in oversea areas.

Naturally there was considerable development and improve-

T/4 Skonieczny awaits evacuation on Saipan. Leg is completely shattered.



Combat photographers record Luzon infantry action on still and movie film.

ment in training film production technique during this period. For much of the best of Hollywood and commercial talent contributed to these productions. Subjects ranged from simple *"how to do it"* films to the more complex *"attitude builders."* Each was designed to fit a specific spot in the training program. And, generally speaking, they did a fine job. The Army was early sold on training films, for their saving of time and wear and tear on instructors.

A well known story dramatizing the effect of training films is that of thirty-six rookies and a timber trestle bridge. The recruits had only three weeks of Army training, none of it in engineering work. But they were shown a Signal Corps film, TF 5-1361, *The Timber Trestle Bridge.* They saw the film once in a darkened room. Then they were taken into the country by a sergeant who had never built a timber-trestle bridge and told to erect the structure. What happened? Here's the answer in a direct quotation from their C.O.: "In three and a half hours they had completed a 45-foot timber-trestle bridge which is as good as any I've ever seen. If that isn't an argument for training films, I'll eat one."

Documentary

Without a doubt, the greatest contribution to the average G.I.'s understanding of the war and the issues involved was made by the *Why We Fight* series of films produced by the Army Pictorial Service under the direction of Colonel Frank Capra. Many of these films were shown in theaters throughout the United States. *Prelude to War, The Nazis Strike, Divide and Conquer, Battle of Britain, Battle of Russia,* and *War Comes to America* are familiar titles to almost everyone. The *Battle of Russia,* was translated by Moscow into a score or more dialects, and with a prologue by Marshal Stalin, was shown throughout the USSR. The *Battle of Britain* and another film of the series, *Know Your Ally, Britain,* with introductions by Winston Churchill, broke attendance records in the British Empire. In recognition of the *Why We Fight* series as the outstanding group of U. S. documentaries of the war and in appreciation of their contribution to the war effort, Colonel Capra was awarded the Distinguished Service Medal.

There are other documentaries. produced by the Army Pictorial Service, which have won for themselves lifetime memberships in filmdom's hall of fame. The epic story of General Eisenhower's campaigns in Europe is told with dramatic simplicity in *The True Glory.* There's *Appointment in Tokyo,* based on the promise, "I will return," and starring General MacArthur, and *The Battle of San Pietro,* the bloody saga of a Texas infantry division. Others include *The Negro Soldier, Don't Be A Sucker* and *Seeds of Destiny.* In a class by themselves are the *Staff Film Reports* and the *Combat Bulletins,* newsreel-type reports of combat and research activities. The horrors of the German concentration camps were shown not only to the American public and to audiences in allied nations, but were released in German versions for prisoners of war, for German civilians, and finally for the courtroom where the prison officials and camp guards were tried for their lives.

Screen Magazine

Enjoying a unique position among Army films is the *Army-Navy Screen Magazine.* Combining fact and fantasy, this two-reel bi-weekly series is neither information, training, nor pure entertainment. It contains a bit of each. Not many months after Pearl Harbor, a celluloid Sad Sack named Private Snafu was adopted by the *Screen Magazine.* Since then he has struggled through a series of adventures that make *The Perils of Pauline* look like kindergarten stuff. His exaggerated gripes and belly-aching have usually landed him right behind the 8-ball. He's had malaria and dysentery, he's been shot at and stabbed, he's fallen out of planes and he's cracked-up jeeps. In addition to being a morale booster and a big brother to all G.I.'s, he's probably hammered home more lessons than any other teacher in the business. *The Screen Magazine* has been shown to American soldiers all over the world from Alaska to New Zealand, from Iran to Panama, in all climates, at all seasons of the year.

Noel

It was the night before Christmas in a coconut grove on a south Pacific island. A couple of thousand G.I.'s had streamed into the grove and sat on newly-hewn logs, hoping for entertainment. There were jeers and cat-calls when the Army-Navy Screen Magazine title hit the screen. But, in the words of a soldier to his sweetheart: "All of a sudden amongst the cat-calls and the hooting, Marion Anderson's voice came out to us singing 'Ave Maria.' Then Stokowski appeared on the screen and said, 'Won't you boys join in and sing with us?' Jeanie, for a minute there was utter silence, then every man in that audience joined in and sang 'Silent Night,' 'Come All Ye Faithful,' 'It Came Upon the Midnight Clear,' and all the other Christmas hymns.

For just a little while we were all transported home again—it was Christmas Eve as we remembered it: Even after we left the 'theatre' the spell held. I wonder how many of us went to sleep that night softly humming those hymns under our breaths."

Industrial incentive films were produced by the Army Pictorial Service and shown to employees of war-supporting industries throughout the United States. These pictures brought the war home to the workers and gave them a keener sense of responsibility for their contribution to the war effort. *The Case of the Tremendous Trifle, The Arm Behind the Army, Soldiers Without Guns* and many others, including a series of *Film Communiques*, contributed immeasurably toward increasing the production output of the war industries. In fifteen months after the program began, the audience grew from 60,000 to 8,500,000 workers a month, with regular screenings in 135,000 war plants.

The Medics

Certainly no single film program of the Army will have more lasting effect than that of the Medical Department. In addition to basic training films in health and hygiene, there were special "V.D." films like *Pick-Up* and *Easy To Get*, reconditioning films and the professional medical series.

Charley McGonegal had both hands blown off by a grenade back in 1917. Fuses were not as dependable then as now. But Charley didn't let that stop him. By using prostheses, with hooks instead of fingers, he had learned to live a normal life, and do for himself all of the little things a man finds necessary in his daily routine. Of course, he dressed himself, shaved, brushed his hair, cleansed his teeth, and tied his shoe strings. To save time he used hooks on his vest in the place of buttons. Not that he couldn't handle buttons, but they were more trouble. During the years since his injury he had held good jobs, ably supporting his wife and children. And could he call his shots on a billiard table! It was really uncanny. But no better than his acting. When he made *Meet McGonegal* for the Army you'd have thought he had a lifetime membership in the Screen Actors Guild. That's why the film was so helpful to those who had lost a leg or an arm in this war. But there was one soldier the film helped especially. He was a sergeant. Both hands had been blown off on D-Day, but not on the beachhead in Normandy. A stick of dynamite had exploded prematurely during training in North Carolina. How this boy, inspired by Charley McGonegal, learned in three months to do what Charley could do and also found the secret of living a normal life in spite of his handicap is told in another film, *Diary of a Sergeant*.

At the request of the Surgeon General, the Army Pictorial Service supplied film and camera equipment to special Medical Department camera teams assigned to hospitals in the United States and to medical units in oversea areas. Toward the end of the war and after cessation of hostilities, Washington received thousands of feet of this film in 16mm color covering every conceivable type of medical activity from narcosynthesis in the treatment of neuropyschiatrics to removing bullets from the heart. Much of this material has been edited, titled and narrated. These films are being released though War Department film libraries for use in the instruction of military and civilian medical personnel.

There is no field of medicine so pregnant with dramatic material as psychiatry. Many of Hollywood's present feature productions are based on psychological and psychiatric problems. And perhaps the most outstanding of all Army-produced films is based on the treatment of patients suffering from war neuroses. It's title is *Let There Be Light*. Were this film shown in commercial theatres in this country it would be a box office success. But its release is limited to accredited medical institutions and professional groups concerned with the subject.

O.M.P.S.

The greatest contribution of the motion picture industry to the winning of the war is that which

Signal cameraman photographs assault on Jap positions in China.

made possible the Oversea Motion Picture Service. Operated by the Army Pictorial Service, the OMPS served at its peak 21 oversea exchanges, handling 43,306 feature pictures and 33,236 short subject 16mm prints donated by the motion picture industry. On one night, 1 June 1945, a world-wide survey showed that OMPS films were seen by more than 1,900,000 soldiers, sailors and marines at over 6,000 separate performances, everywhere from a few hundred yards back of the front lines to captured theatres in occupied territory. World premieres were more often the rule than the exception for troops overseas. "Celluloid therapy" in rest areas cured many

a case of combat fatigue without benefit of medical care, in less time and with considerably less expense.

Bromide

There's the old gag about the farmer who went to the circus and saw a giraffe for the first time. For a long while he stood there watching the cud-chewing mammal towering more than ten feet above him. Finally he spat a mouthful of tobacco juice at a log near the fence, turned away and said, "There jest ain't no sech animule."

That's the way you'd feel if you took a look at one of the Army training films which has been translated into Chinese. Everything looks strictly G.I.—the 2½ ton truck, the private who's changing a tire, even the sergeant who's always got his mouth open. But something's wrong. That sergeant is reeling off Chinese like a coolie. It just ain't so! But it is. The effect is achieved by "lip-sinking," or matching the recorded Chinese translations with the lip movements of the original actor who was actually speaking in English. The Army Pictorial Service has translated almost 200 training films into Chinese. Others were rescored in French for Free-French troops under General De Gaulle, in Italian for use by Italian Service Units in this country, and in Spanish and Portuguese for use in Latin America. To date approximately 1,000 different film subjects have been rescored in foreign languages by the Army Pictorial Service.

Post War

Yes, the war's over. But the shooting hasn't stopped—not for the Army Pictorial Service. There's work and more work to be done—with fewer, many fewer, people to do it. As long as troops are overseas Signal Corps cameramen will record their activities. The pictorial records of the war—the millions of feet of motion picture film and the hundreds of thousands of still picture—they are being evaluated and assembled in permanent form. Newly-inducted soldier photographers are being trained at the Signal Corps Photographic Center to replace veteran cameramen who are being discharged. The Still Picture Laboratory in the Pentagon is operating at full capacity, with the addition of a new color section devoted to the preparation of color prints from Kodachrome and Ansco transparencies. Motion picture and film strip production at the Signal Corps Photographic Center are again on the increase, following a lull immediately after cessation of hostilities. Close military cooperation between the United States and Latin America means continuation of the rescoring program. Many films made during the war are already obsolete. New doctrine and new tactics have been developed. New weapons have been introduced. Atomic warfare with all its many

Col. W. W. Jervey is Chief of A.P.S.

ramifications must be given consideration. New problems of troop morale require films for presentation. Reorientation of enemy nationals in occupied areas demands full use of all methods of information dissemination.

There still seems to be no particular connection between photography and signal communications, but it looks like the Signal Corps is in the film business—to stay.

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APS makes identification photos.

EDITORIAL

Industrial Readiness

Industrial mobilization planning is now gathering headway. ASA has offered its services to the Army and the Air Forces and to the Army-Navy Munition Board to expedite the preparation of so much of the plan as involves communication and photographic equipment procurement. Legislation necessary to provide for total and immediate mobilization of industry in the event of another war is soon to be considered by the Congress. The proposed bill would incorporate most of the features of an M-Day plan prepared by the War Department during the years before World War II but never activated. One Congressman stated that World War II would have been shortened by six months if that program had been used.

The Army-Navy Munitions Board is proceeding with the stock-piling of "strategic materials." There are fifty-two items on this list, many of them essentials in the manufacture of communications and photographic equipment. Over $500,000,000 will be spent in this program during the period ending 1 July 1948, if Congress approves.

The newly established Joint Research and Development Board is forming committees on which outstanding scientists and engineers will serve. They will specify responsibility between the Armed Forces for research and development in the several fields. The executive director for the committee on electronics, Norman L. Winter, former AAF colonel, is well chosen for the unit which is most closely associated with ASA interests. Panels on radar, communications and counter-measures have already been appointed. Dr. Vannevar Bush, head of the JRD Board, is contemptuous of "push-button warfare." He says: "Push-button warfare be damned. This talk has done a lot of harm."

The "Munitions Board," as the Army-Navy Munitions Board will be called under the Department of National Defense, will coordinate appropriate activities within the National Defense establishment with regard to industrial matters: procurement, production and distribution. It will also assign procurement responsibilities to the several military services, plan for standardization of specifications and for allocation of purchase authority for technical equipment and common-use items on the basis of single procurement. It will correlate military requirements with the civilian economy.

The Research and Development Board will "advise with regard to trends in scientific research relating to national security and the measures necessary to assume continued and increasing progress."

First National Convention of ASA

Army Signal Association will attain its first birthday in May—a brief existence in comparison to the half-century records of some others of the military associations, but a lusty and promising beginning. The first annual meeting and convention of the Association will be held at New York and Fort Monmouth on 28-29 April. At this meeting final action will be taken on the election of officers and directors, the adoption of a permanent constitution and by-laws, and the presentation of the first annual report of activities. The first exhibition of military communications and photographic equipment will be presented. We hope this event will become as popular and important in our field as the annual Ordnance show at Aberdeen is in its sphere.

A large attendance at the convention would mark this first year as an outstanding success during a period when some other military associations are reporting 1946 as one of the worst depressions in their history. It will indicate beyond any doubt that there is in continuous existence a great team of military and industrial groups and individuals interested in communications, photography and their allied fields—contributory to the prevention of fatal delays in meeting any future attack on our country.

Universal Military Training

As expected, the President placed universal military training high in priority in recommended legislation by Congress. The present draft law expires in March of this year. The President's Advisory Committee, headed by able Dr. Karl T. Compton of M.I.T., is due to report its recommendations in May.

The organized educators have been one of the most vocal groups opposed to universal training. The reverse should be true, for two reasons. With a properly organized educational program by the Army, many brilliant minds, often possessed by young men without financial means for higher education, will be discovered and they will probably be sent to universities on scholarships after they have finished their military training. The desire for higher education would be whetted rather than diminished—a fact proved by the tremendous rush by veterans to schools and colleges under the G. I. Bill, and their superior academic records while there.

Those responsible for the National security have endeavored for years to find an effective substitute for universal military training as an essential measure to prevent America from becoming impotent. None has yet been found, nor is it likely that the haphazard measures used in former years and which are now again advocated in some quarters, can ever adequately provide for the nation's defense.

History does repeat itself. The splitting of the uranium atom will not usher in the elusive Utopia of eternal peace. Wars will again be launched against nations unable or unprepared to defend themselves. America will approach this condition unless a strongly concerted effort is made to provide basic military training for all able-bodied citizens, to select the best for training as leaders, and to classify all men to assure their assignment to duties for which they are best qualified and most needed. A push-button atomic or rocket war will make organized, disciplined manpower more important that it has ever been before. It will be vital that we prepare our men and select our leaders during the peace—to insure its continuance.

Allied and enemy planes leave vapor trails in dog-fight over Germany.

Jap envoys negotiate unconditional surrender at Manila, 1945.

Ribbon parachute is inserted in war-head of German V-2 rocket.

U. S. Army wire spans Brahmaputra River near Bilasipara, India.

New Chief Signal Officer Maj. Gen. Akin chats with Joe E. Brown.

Stanford White designed this stately National War College building.

German scientists working on rocket experiments in New Mexico.

ARTICULATION FOR PEACE

By Harold J. Wheelock

A global communications system must be provided if United Nations is to realize its high purpose

OUT OF THE CHAOS and ruin of World War II has been conceived, for the second time in a quarter-century, a structure around which men who have preserved their freedom at horrible cost propose to build a truly lasting peace.

The United Nations is the most promising experiment in a brotherhood of man yet attempted. The new organization carries the last desperate hopes of sobered men for the integration of differing racial strains and cultures, social and economic ideologies, in a cohesive commonwealth of nations.

Looking toward the firm establishment of United Nations on a world-wide operating basis, the first session of the General Assembly, meeting at London in February 1946, approved a resolution to provide radio broadcasting facilities "both for communication with members and with branch offices, and for the organization of United Nations programs."

In this action the Assembly recognized that communications would be the real nerve-center of the peace establishment; that the strength of the organization would be directly proportionate to the adequacy of a radio network that could activate the enforcement agencies with the speed of an electrostatic impulse.

Accordingly, in September the Secretary-General appointed a Panel of Radio Experts, now the United Nations Telecommunications Advisory Committee. This group was headed by Brigadier General Frank E. Stoner of the United States Army and included as members Mr. S. Kagan, formerly Chief Signal Officer for De Gaulle's Free French Forces and Chief of the French Telecommunications Mission; and Mr. G. F. Van Dissel, Chief of the Communications Department, Netherlands Purchasing Commission, one-time member of the Transit and Communications Section and Director of the Wireless Section for the League of Nations.

General Stoner was particularly well qualified for the as-

"a structure around which...to build a truly lasting peace."

signment because of his extensive Signal Corps experience with the pre-war Alaska Military Communications network and his function, throughout the second war, as Chief of the vital Army Communications System which operated on a true global basis. Promoted to Major General in 1944, he was appointed Assistant Chief Signal Officer in December 1945, a position he has resumed since the termination of his United Nations assignment.

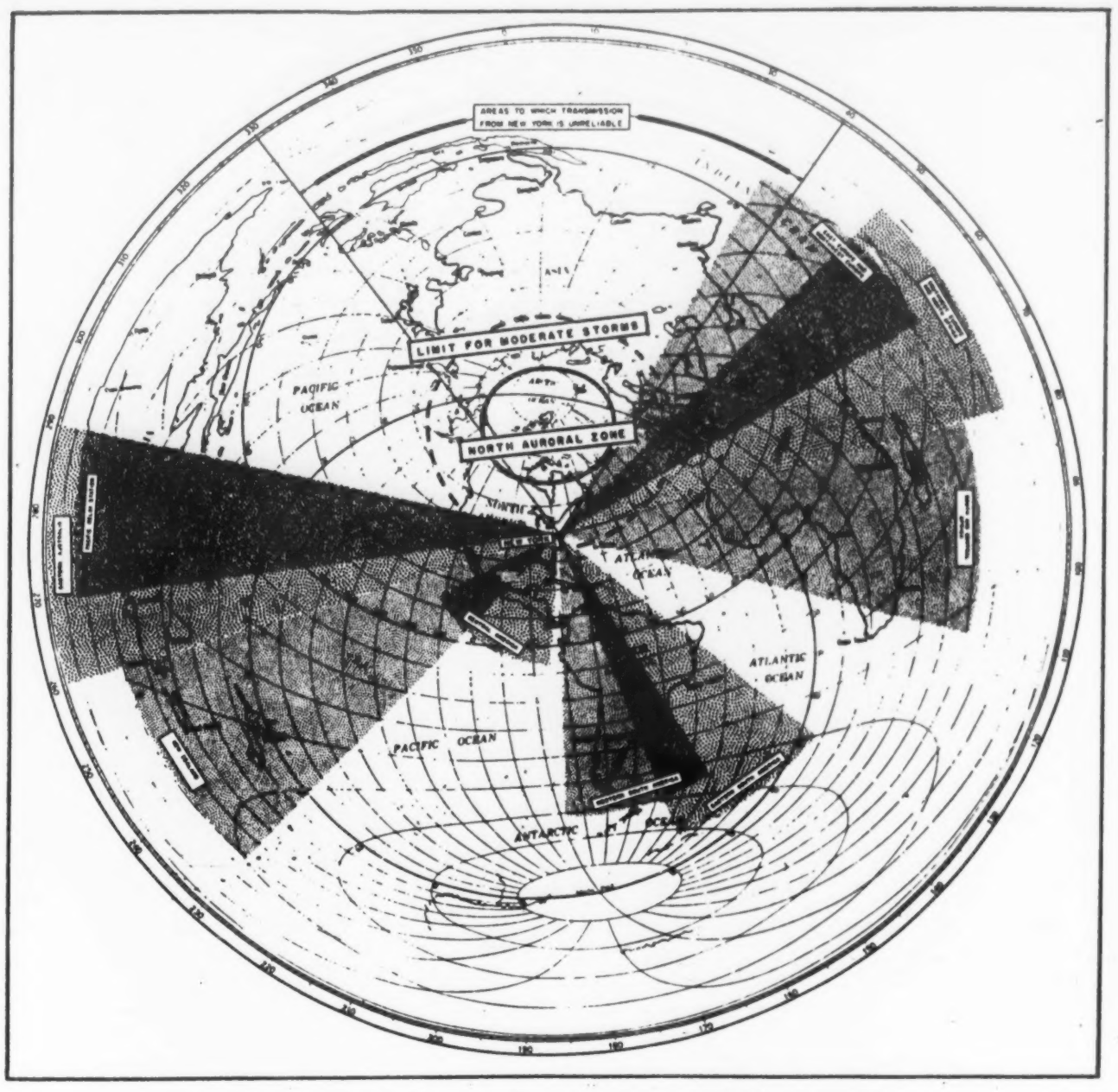
The Task

The Advisory Committee was charged with three distinct but interrelated duties: to prepare a plan for efficient world-wide broadcast coverage of the first General Assembly proceedings; to recommend United Nations broadcasting and telecommunications arrangements during the period between the close of the Assembly and the establishment of a permanent headquarters; and, to prepare plans and technical data for independent United Nations radio communication with the governments and peoples of all Member States.

The target date for the initial report was 10 November 1946, at which time a group of five telecommunications experts met with the Committee to review the recommendations before their presentation to the Secretary-General and the Assembly.

The five consultants were widely experienced in communications. Mr. Wen Yuan Pan was formerly technical adviser for China Defense Supplies and the International Civil Aviation Conference in 1944. Colonel Hassan Bey Ragab is Military Attache at the Egyptian Embassy in Washington, once was in command of the Egyptian Army Telecommunications Maintenance System. Mr. Sergei P. Gavrilitsa is Radio Engineer in charge of communications for the Soviet Delegation to United Nations. Brigadier John G. Deedes was former Deputy Director of Signals in the British War Office and is now Telecommunications Attache at the British Embassy. Mr. Roberto Fontaina is president of SADREP, largest commercial broadcasting network in Uruguay.

The Committee had many and varied problems to consider in planning a world-wide broadcasting system. Factors to be reckoned with included geographical distribution of listeners, seasonal and ionospheric variations in transmitting conditions, sun-spot cycles, and the available receiving equipment and listening habits of some hundreds of millions of people in fifty countries and on every continent. Facing a probable 24-hour operating schedule, the securing of proper frequency allocations had to be considered at a time when near-bedlam prevailed across the entire radio spectrum. Finally, equipment requirements and cost estimates had to be made an integral part of the plan.



Areas to which New York transmissions will be beamed.

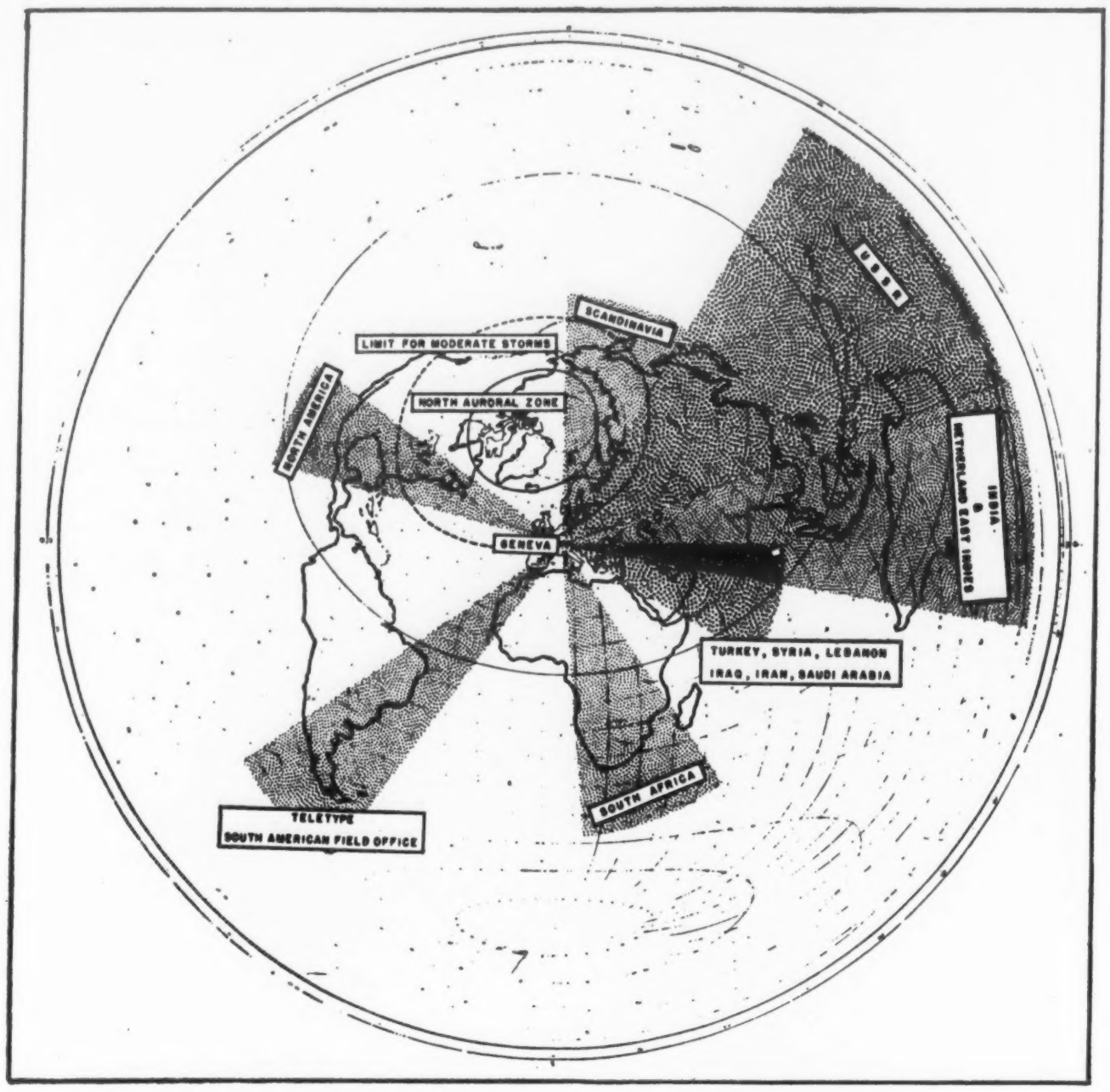
The first objective of the directive has been accomplished. The General Assembly proceedings beginning last October were broadcast by arrangement with the United States Department of State and the Canadian Broadcasting Corporation. Limited coverage was provided to Europe, Middle East, Africa, Latin America, Far East, India, Australia and New Zealand. Recommendations for interim telecommunications facilities, pending the permanent establishment of the international headquarters, are in abeyance until the adoption of the overall plan by the General Assembly.

In estimating the long-range requirements of the organization the Advisory Committee made a detailed analysis of data submitted by fifty Member Nations. Listening habits were tabulated; program preferences, language patterns and types of receivers were listed.

It was found that approximately 300,000,000 people throughout the world hear some form of radio broadcast each day. The great majority listen to their local national networks on the standard broadcast band. A mere 5% of the world's population have receivers with a frequency coverage that includes the high-frequency international broadcasting channels. Thus the Committee felt that the largest audience would be reached by establishing feeder outlets for piping United Nations programs into existing national networks on the broadcast frequencies. Programs originating at the international headquarters or at one of the field offices could be received, amplified and fed into the local stations by land-line or microwave radio relay.

The Broadcast Plan

The ultimate objective of the United Nations network is to



The Geneva relay station will provide broad coverage.

provide the most extensive world broadcast coverage possible and simultaneously to furnish a telecommunications system for the transmission of official traffic between the international headquarters and the principal field offices.

The system will transmit programs on only the highest cultural level: music, economic, agricultural, medical, vocational, educational. It is anticipated that all specialized agencies within the United Nations structure will use the network facilities for mass communications. These include UNESCO, International Labor Office, the World Bank, and the World Health Organization.

International exchange of programs between existing networks and stations within the various nations will be encouraged at all times. United Nations broadcasts will not be censored and all Member States will be allowed equal use of the facilities when controversial questions are before the Councils or the General Assembly.

Programming will be the responsibility of the Department of Public Information, an agency headed by Benjamin A. Cohen of Chile. The finest available talent will be obtained and no effort will be spared in making United Nations broadcasts an effective medium for the establishment of international understanding and cooperation.

Beside point-to-point transmissions for re-broadcast and direct short-wave services, the plan includes the export of recordings and script material for presentation by local stations in Member Nations. Plans envisage the use of all these methods on a global basis, combining international broadcasting with a press service and telecommunications system that will afford the United Nations the greatest economy in plant facilities, frequencies and operating costs.

The important listening hours in all target areas are somewhere between 6 P.M. and midnight, local time. The general broadcast schedule provides maximum coverage during those periods in all time zones. Service during other hours would depend upon transmitter availability and the importance of the program material. Language requirements necessitate "threading" each transmission to restricted linguistic areas, increasing the complexity of the scheduling process.

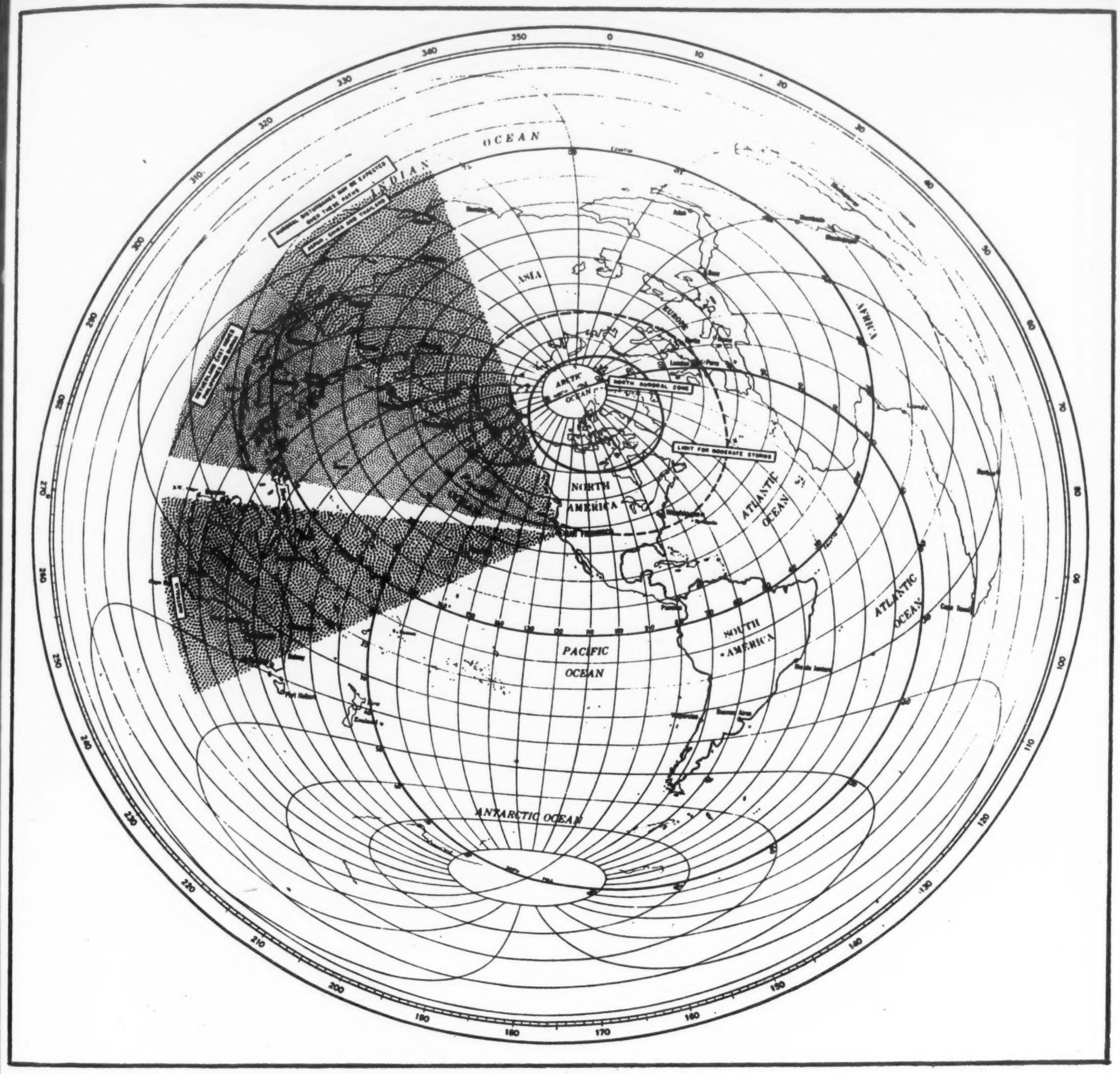
A typical operating schedule for the General Headquarters station during the optimum hours shows all of the five transmitters in use to Europe and Africa: one for South and Central Africa, one for North Africa and the Mediterranean; and the remaining three available for division among the numerous European language zones. One of the 100-kilowatt transmitters is designed for relay feed during minimum listening hours in Europe. At that time the European Field Office could record programs for re-broadcast to the Continent. Certain of these marginal hours are optimum in such places as India and Malaya and programs intended for European transcription could be relayed directly from Geneva simultaneously with the recording process.

The voice channel of the suppressed carrier, single side-band circuit indicated for the European service could also be used as a relay feed, making it unnecessary to assign more than one transmitter to this area although several program threads would be continuously in transmission.

As optimum listening time in the Eastern Hemisphere closes the transmitters at Headquarters Station would be transferred to South and Central American services and later to New Zealand, Australia and eventually to Eastern Asia. Very little idle time is anticipated and the equipment load factor should remain consistently high.

It has been recommended that the important European area also be served by a United Nations 1000-kilowatt transmitter operating in the low or medium frequency bands (180 to 300 kc. or 535 to 1605 kc.). This service would reach a large audience on frequencies to which they normally listen.

The eleven-hour schedule for Pacific area transmissions would not make the most efficient time-use of equipment designed for this service. Nevertheless, it is highly essential that adequate coverage be provided to Asia and the Islands regardless of local problems peculiar to the regions. If the relay station is located in California, wire lines could be leased and programs could be transmitted without use of head-



Pacific area beams plotted from San Francisco.

quarters equipment. Transcription and script services could also be furnished for local regional broadcasts.

Written Record Traffic

The United Nations communications system will not carry official traffic between Headquarters and Member Nations, nor will the network compete with commercial carriers in point-to-point message handling.

Traffic volume to members will be large, increasing as the various departments and agencies expand to permanent strength. This material, plus internal administrative circulars, orders, bulletins and documents will exceed a million words daily. All American common carriers will have offices at Headquarters and their services will be used in transmitting official business to and from Member Nations and in distributing releases to private press associations. The one exception is the Geneva Field Office where the volume of official traffic will justify the use of United Nations facilities for that purpose.

A six-channel radio printer circuit at 60 words per minute has an ultimate daily capacity of about 500,000 words in each direction. Allowing for frequency changes, maintenance and uneven traffic flow, 250,000 words can be taken as a practical daily average for United Nations. The traffic possible in each direction would fill about 30 pages of a standard 8-column newspaper.

Provisions have been made for the use of International Morse Code when ionospheric storms are in progress. Tape perforators, transmitting heads and recorders are indicated for this service.

The planning of only two high-capacity circuits from General Headquarters to Field Offices establishes the latter as clearing houses for their areas. Thus a

considerable saving in message handling will be effected by channeling a portion of the long-distance traffic through local commercial routes, which will distribute written record inter-office traffic to other field offices.

The Frequency Problem

Frequency allotments will be a seriously acute problem. Allocations are controlled by the International Telecommunications Union, with offices at Berne, Switzerland. The last general convention of I. T. U. was held in 1938 at Cairo but since the war many countries are allowing their stations to operate without regard to the Cairo agreements. Consequently the low- and high-frequency bands are in a state of confusion.

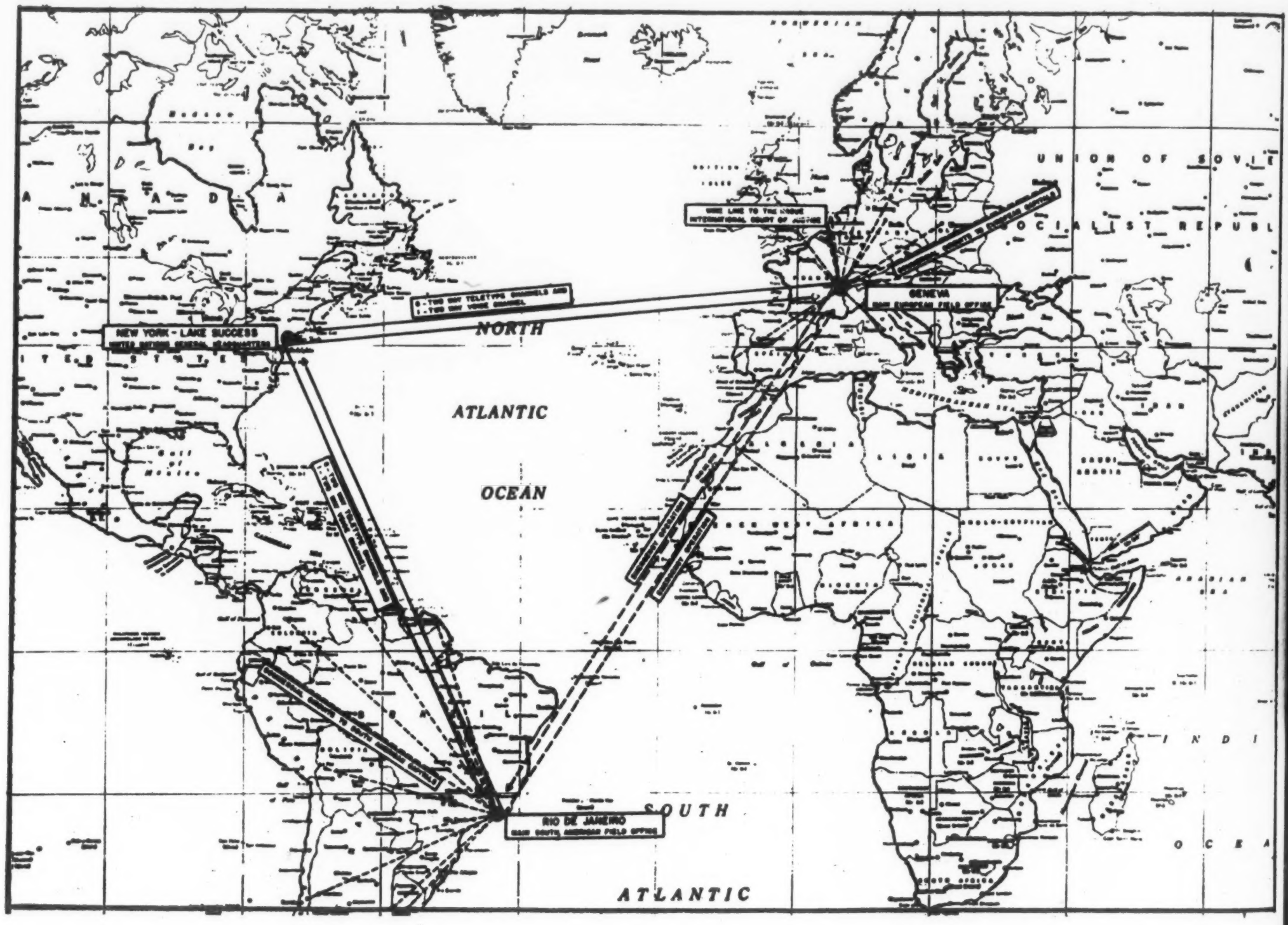
The Cairo meeting specified only 4% of the channels between 4 and 20 megacycles for general broadcasting. These are the most useful channels for long-distance transmissions. It will be extremely difficult, perhaps impossible, for United Nations to obtain the necessary frequencies from I. T. U. at the Atlantic City Convention in May 1947 because of the enormously expanded commercial and national services that will be clamoring for allotments on all bands.

Fortunately the United Nations, which will need a conservative minimum of twelve frequencies in the short-wave band, can legally claim those formerly allocated to the League of Nations and current plans provide for their acquisition.

The League had reserved a number of frequencies for radio operations and the Assembly in 1929 decided to allow Radio-Suisse, a Swiss Company, to operate its facilities. This was done because the League did not have federal status and could not negotiate for frequencies with I. T. U. The Swiss firm was government controlled and could apply for the operating channels. In the frequency lists published by I. T. U. the wavelengths are recorded under Radio-Suisse with the notation that they will be used by Radio Nations, the League's official station. The Swiss company performed the technical functions; all programs were arranged and broadcast as a direct responsibility of the League of Nations.

In 1939 Radio Nations ceased operating because of the war. The Swiss Government then denounced the 1930 agreement, an action in full accord with terms of that document. Subsequent negotiations resulted in sale of the radio facilities to the Swiss authorities for 265,000 Swiss francs but no reference was made by either party to the frequencies that had been reserved for the League in the name of Radio-Suisse.

Later lists, however, showed many of the League's frequencies registered under Radio-Suisse without mention of the League



Basic written-record traffic circuits for inter-office communications.

of Nations. The Swiss apparently appropriated many of the frequencies for their own use and abandoned the remainder.

United Nations intends to claim the frequencies formerly assigned to the League but difficulties will be considerable. An appropriate status must be established for United Nations and a solution will be sought at the forthcoming International Telecommunications Conference to be held this year. Negotiations have been started with the Swiss Government and the matter was brought to the attention of the Five Power Telecommunications Conference in Moscow.

The Technical Plan

Basically the Committee outlined a system for world-wide coverage using one primary and two or three secondary or relay stations. Additional relay stations are planned for a global belt-line that would form a multi-channel system around the earth in the Equatorial and North Temperate Zones, the regions of most uniformly favorable transmitting conditions. With the tie-in to national networks the belt-line would give United Nations a complete world coverage at minimum cost, maximum efficiency.

Initially planned are a Headquarters Stations, probably located on Long Island; a European station that will relay and originate programs, in the vicinity of Geneva, Switzerland; and a Pacific area relay station, either in California or Hawaii. A Latin American outlet is provided as the organization expands into permanent form.

Radio transmissions through regions of ionospheric storms are likely to be erratic and these areas restrict the coverage that can be obtained from a transmitting station on the east coast of the United States. For sustained periods it is only possible to serve reliably from New York those regions lying between an azimuthal bearing of 40° true east to 330° true, thus excluding parts of Eastern Europe, Asia, the Philippines and certain other Pacific Islands.

This condition can be alleviated by using relay stations, one of which would be located at the Main European Field Office, probably near Geneva, Switzerland. From there Eastern Europe, most of Western Asia, India and the western regions of China can be reached.

Another relay will be necessary to provide adequate service to Japan, the Philippines, the Indies, Eastern China and the remainder of Asia.

Each short-wave broadcasting centre will be fully equipped with transmitters, receivers, di-

"the voices of indignant men must be joined in common chorus..."

rectional antennas and terminal equipment. Broadcast transmitters will operate at 100 and 200-kw. and 50-kw. amplifiers will be

Major General Frank E. Stoner headed the U. N. Telecommunications Advisory Committee. He recently retired from Army, and will permanently affiliate with U. N.

provided for low-power single-side-band exciters. The European office will have the 1000-kw. low-frequency transmitter for the special Continental service.

The United Nations communications system can avail itself of the war-developed techniques that cost the Allied nations more than $1,000,000,000. Equipment recommended is commensurate with the highest state of the art. "Exalted carrier" receivers will effectively reduce selective fading, a troublesome phenomenon in high-frequency communications. Single side-band transmitters will conserve space on the spectrum and improve quality of reception. One side-band is suppressed by this method, or if both are used a telephone circuit can be channeled on one side-band and six or more teletype circuits operated at 60 words per minute on the other. Directional transmitting arrays and spaced-diversity reception will vastly improve the quality and dependability of transmissions.

All broadcast transmitters operated at General Headquarters and the European relay station are to be equipped for simultaneous frequency-shift keying. This system can be superimposed on broadcast voice transmissions without impairing their quality and provides a simultaneous "que" circuit or press and inter-office dispatch system.

Special receivers are required for demodulation of the keyed signal, which can operate either teleprinters or automatic Morse code equipment. These receivers are proposed for the General Headquarters, the European, Asiatic and Latin American Field Offices, and at twenty additional locations yet to be determined.

Frequency-shift transmissions will only be available when a broadcast station is beamed to a given area. However, European service is proposed for all but four hours daily, there is nine-hour service to East and West South America and from four to eight hours to other regions, plus relay station coverage.

This service will be especially valuable for general bulletins to all branch offices. These would normally be transmitted "blind" but on important occasions acknowledgments could be requested by commercial carrier or through one of the two Main Field Office Message Centers.

Exalted carrier dual-diversity receivers have been recommended for use at General Headquarters and the European Field Office stations. At Geneva they would be used primarily for receiving transmissions designed for re-broadcast. At New York they would receive programs originated in various countries as part of the general program schedule.

Twenty simple diversity receivers will be supplied for use in frequency-shift teletype service. They will also be used in the branch offices for receiving programs that will be relayed by wire lines to local domestic networks. The voice channel of the single side-band transmitters will also serve this purpose for Europe, later for South America.

Studios

An elaborate studio installation has been designed for General Headquarters. Twelve separate programs can be fed simultaneously to the transmitters and the common carriers of the United States networks. Twelve recording lathes will be available for transcriptions. A dozen broadcasting studios is considered absolute minimum.

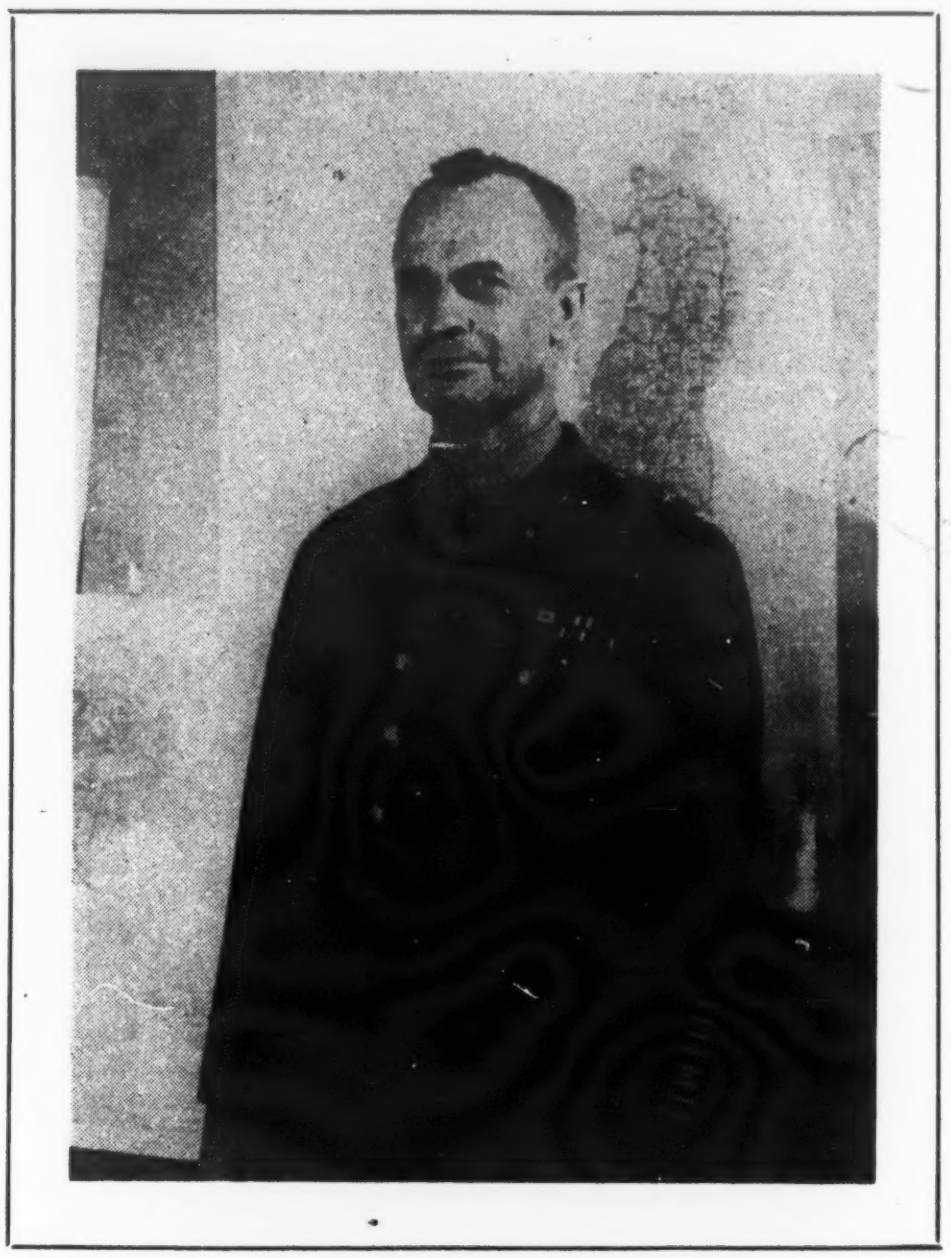
Procurement and installation of the equipment, estimated to cost $6,000,000, will require two years. It is proposed that all purchases be made from sealed bids, invited from all Member Nations.

The Objective

The United Nations network is projected on the grand scale; it is the most ambitious communications system ever devised. From the throb of savage drums and the free flight of smoke signals, human intercourse has advanced to this—the largest audience in history, scattered about the entire perimeter of the earth.

With the victory achieved it is essential that the peace be firmly secured. The message of mutual understanding and trust must reach into every city and town, into every land, into every continent. Through communications the voices of indignant men everywhere must be joined in common chorus if our civilization is to remain a permanent heritage. To that end the United Nations must be rendered articulate.

The threat of atomic warfare makes the task of the United Nations desperately urgent.



Major General Spencer B. Akin

New Chief Signal Officer of the Army

MAJOR GENERAL SPENCER B. AKIN'S appointment as Chief Signal Officer of the Army climaxes a long and distinguished military career.

Born in Greenville, Mississippi, in 1889, he graduated from Virginia Military Institute in 1910 and was commissioned a second lieutenant of Infantry. General Akin's early duty included Philippine service, 1911-1914, and Signal Officer of the 20th Division, 1918. He was successively Signal Officer for the First Infantry and the First Cavalry Divisions. After attending the Infantry School, Command and General Staff School and the Army War College he became Signal Officer of the Panama Canal Zone Department in 1936.

He was in charge of Signal Intelligence at Washington, served as Signal Officer for the Third Army in 1941 and then returned to the Philippines as Signal Officer of the United States Armed Forces in the Far East. He served at Bataan and Corregidor and escaped with General MacArthur to Australia in March, 1942. For valor in defense of the Philippines he was awarded both the Distinguished Service Cross and the Distinguished Service Medal.

General Akin served as Chief Signal Officer with General MacArthur throughout the Southwest Pacific Operations and during the occupation of Japan. His other functions included Chief of Civil and Postal Communications Section, Chief of Signal Intelligence Service and of Radar and Radio Counter-Measures Service in the Far East, the Southwest Pacific Area and the Army Forces of the Pacific.

During World War II, in addition to other duties, he established and became Chief of the Research Section of General Headquarters, Southwest Pacific Area. He was appointed Brigadier General (Temporary) on 18 December 1941 and Major General (Temporary) on 3 November 1943. He reverted to the rank of Brigadier General (Temporary) on 1 May 1946.

The new Chief Signal Officer has an imposing combat record which, coupled with his specialist training and staff experience, admirably qualifies him in his new assignment. In addition to the Distinguished Service Cross and the Distinguished Service Medal, General Akin has been awarded the following decorations: Oak Leaf Cluster to Distinguished Service Medal, 1945; Silver Star for gallantry in action, 1942; Silver Star with Oak Leaf Cluster, gallantry in action, 1944; Air Medal, gallantry and contribution to successful operations of U. S. Air Forces, 1946; Legion of Merit, 1946; Commander of British Empire for bravery in action and distinguished service in operations, 1945; and the Philippine Commonwealth Distinguished Service Star, 1945.

Major General Harry C. Ingles

The Retiring Chief Signal Officer of the Army

GENERAL INGLES started his service in the Signal Corps in 1917. Since then he has held many important signal assignments including: instructor in communications at the Command and General Staff School, Director of the Signal School, Signal Officer of the Philippine Division and of the Third Army.

In September 1939 General Ingles went to the Caribbean Area, where he was Signal Officer, commanded the Mobile Force and was Chief of Staff during the early part of the War. Lieutenant General Andrews, the Commander of pre-invasion forces in the European Theater of Operations, selected General Ingles to be his Deputy Commander.

In June 1943 General Marshall assigned him to succeed Major General Olmstead as Chief Signal Officer of the Army. General Ingles made special and untiring efforts to visit and know the officers and enlisted personnel of Signal Corps units all over the world, especially in the active overseas theaters. For his wartime service as Chief Signal Officer, General Ingles was awarded the Oak Leaf Cluster to the Distinguished Service Medal which he had received earlier for service in the Caribbean. The accompanying citation read, in part: "Technological advancements made under his direction included the application of communications equipment in the field of psychological warfare, the development of radar to a degree which made it one of the most formidable of weapons, the use of radio relay systems for bridging inaccessible terrain, the use of panoramic reception for visual monitoring over wide frequency spectrums, the adoption and extensive use of teletypewriter and radiophoto transmission equipment and the use of highly secret cryptographic systems."

Since war's end he has placed particular emphasis on the Signal Corps' research and development program which contemplates the maintenance of a small, active staff of experienced technical men to work with industry in the design and development of equipment as a basic foundation for rapid expansion in case of emergency. Not the least important of his contributions toward national preparedness was his leadership in founding ASA. In addition to the B.S. awarded him upon graduation from U. S. M. A. in 1914 he has Honorary Doctor degrees from the University of Nebraska and Brooklyn Polytechnic Institute. He graduated from Signal School, Command and General Staff School, War College and served on the War Department General Staff. He has been decorated for distinguished service by Britain, France, Venezuela and Colombia. General Ingles retired from the Army 31 March 1947.

Eye in the Sky

by Leonard David Callahan

Radar Division, Gilfillan Bros., Inc.

RIVALLING Kitty Hawk in aviation history, GCA nullifies the weather in aircraft operation, provides the visual acuity of the hawk in flight control—a "seeing-eye" that penetrates the heaviest fog, guides planes down a glide path to the ground in complete safety.

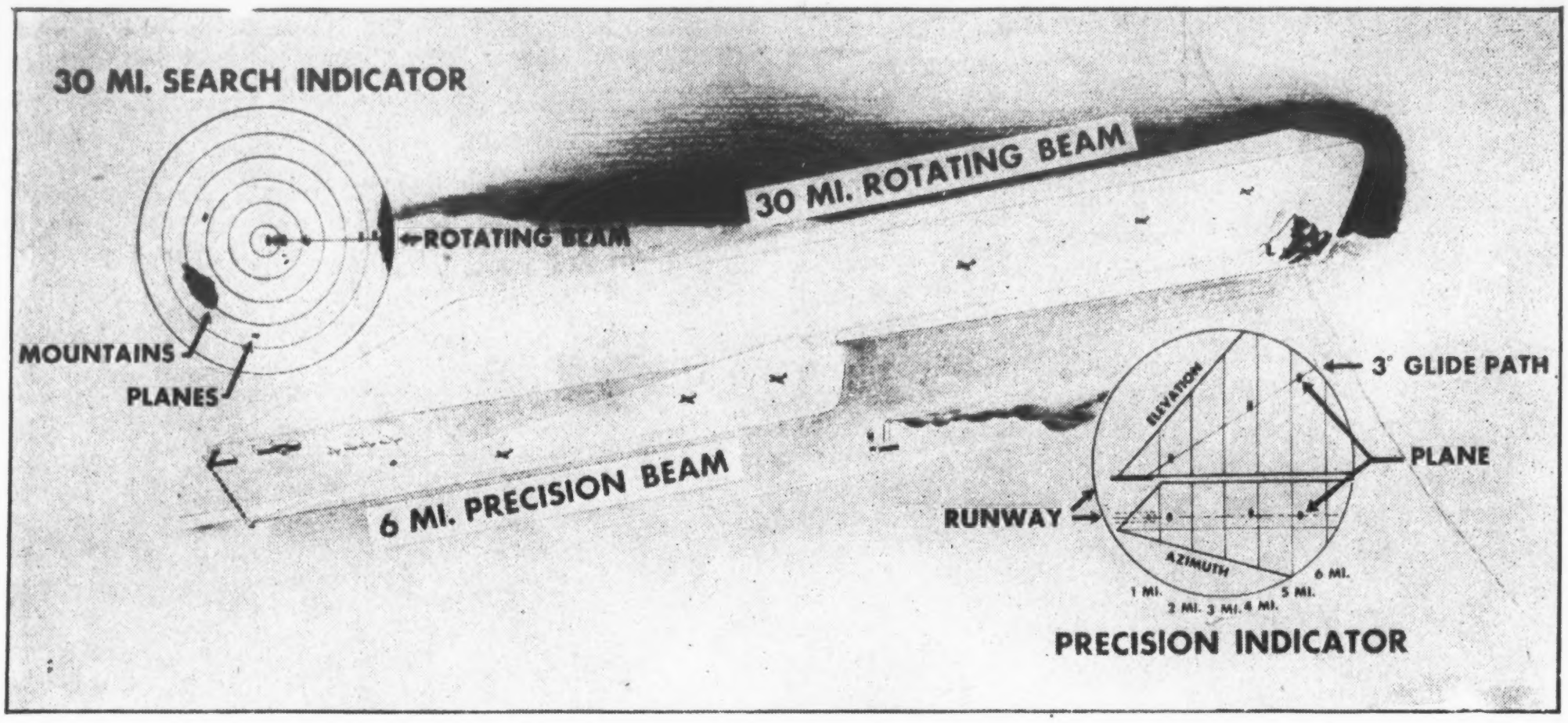
In recent months GCA, a military weapon with an outstanding war record, has been hailed as the answer to civil aviation's most serious problem: safe and regular operations in adverse weather conditions.

GCA Honored

On December 17, 1946, Dr. Luis W. Alvarez was awarded the Collier Trophy by President Truman "for his conspicuous and outstanding initiative in the concept of, and his contribution to, the construction, adaptation and effective demonstration and use of the Ground Controlled Approach System for safe landing of aircraft under all weather and traffic conditions." The Collier Award Committee voted unanimously for Dr. Alvarez and referred to GCA as "the greatest achievement in aviation in America, the value of which has been demonstrated by actual use during the preceding year of 1945."

In January, three GCA units, modified for one-man operation in airport control towers, were installed at LaGuardia Field,

. . . GCA literally opens new, unseen horizons for commercial and military aviation



Panorama of GCA precision and search system.

Washington, D. C. National Airport and at Chicago Municipal Airport. These installations were made possible through the joint efforts of the AAF, the CAA and the Air Transport Association.

The U. S. Navy officially adopted GCA last year as the official instrument landing aid for all naval land-based aircraft. The Royal Canadian Air Force has recently made GCA its standard instrument landing system.

It is understood that the Army Air Forces, who have publicly indicated their preference for GCA over other landing aids, may also soon make this position official. Official evaluation tests conducted by the Army Air Forces in cooperation with the CAA at the CAA Experimental Station at Indianapolis overwhelmingly established the superiority of GCA over other instrument landing systems. Ninety-one pilots selected at random from various branches of the air forces as well as airline and CAA pilots made successive approaches in a hooded C-54 first on GCA and then on ILS. Their deviations from the glide path and the approach course were recorded on Easterline-Angus graphs and the results were tabulated. Typical of the remarkable superiority of GCA, was the score made by a group of fighter pilots from the Fifteenth Air Force, who, with an average flying experience of 805 hours and no prior GCA landings, were 350% more accurate in their runway alignment than the Control Group of pilots with an average flying time of 3,640 hours and a prior average of 110 ILS landings were able to accomplish in their ILS test runs.

GCA History

Colonel Stuart P. Wright was the first pilot to make a completely blind GCA landing under actual instrument conditions. On a visit to East Boston Airport as an observer for Major General H. M. McClelland, then AAF Director of Technical Services, Colonel Wright volunteered to test the equipment when sudden snow flurries and soupy weather prevented the regular pilot, who had no instrument rating, from flying. With Dr. Alvarez acting as final controller in the laboratory GCA model, Colonel "Stud" Wright took off in the snowy "soup" and made ten approaches and landings to convince himself the first few perfect landings weren't "luck." Colonel Wright's enthusiasm was so high that he insisted on General McClelland making a special trip to Boston to witness the amazing ability of GCA to overcome the weather bogey. After personally flying GCA and convincing himself of the potentialities of the radar equipment to "see" aircraft and direct them to safe landings, General McClelland returned to Washington and arranged the demonstration which took place at the Washington Airport in May, 1943. Thereafter, it was General McClelland who, by reason of his personal conviction of GCA's value to military operation and his Scotch determination, succeeded in persuading the AAF and the RAF that GCA was not just a monstrous gadget but a solution to the pilots' worst problem, how to land his aircraft at the scheduled airbase safely and on time.

In May, 1943, following the first field tests arranged by General McClelland at Washington National Airport of the laboratory model, the OSRD gave Gilfillan Bros., Inc. of Los Angeles, California, a contract for the development and production of ten experimental GCA mobile trailers. Seven and a half months later—December 30, 1943—the first of these GCA units rolled off the production line and went into field tests. This amazing record is even more remarkable when it is realized that, electronically, GCA was the most complex radar unit ever produced under a Signal Corps procurement. Weighing 22 tons and containing 705 radio and cathode ray tubes, this equipment, comprising over 100 components, electronic and mechanical, is indeed a scientific marvel.

Major General William Henry Harrison, then Chief of the Procurement and Distribution Services, Office of the Chief Signal Officer, Brigadier General Tom Rives, Chief of Electronics Division, Air Materiel Command, Wright Field, and Colonel Oscar Maier, then Chief of Camp Evans Signal Laboratory, witnessed the first official demonstration of the GCA unit in Los Angeles on

January 28, 1944. This unit was immediately rushed to England aboard a British warship with Captain Neal A. Jolley and a crew of AACS personnel and solved the problem of safely landing planes of the Royal Air Force and the Eighth Air Force in instrument weather conditions. Thereafter, the Signal Corps approved production of an additional 102 GCA units designated as AN/MPN-1 and between June, 1944, and May, 1945, a period of exactly twelve months, the entire 102 GCA units were delivered to the Army Air Forces by Gilfillan.

General McClelland's confidence was rewarded when GCA went into action in England, Europe, the North Atlantic, the Aleutians and all through the Pacific theater. Hundreds of airmen and millions of dollars worth of aircraft were saved through the magic of this radar device. It was stated officially that the B-29s saved by GCA at Iwo Jima alone more than paid for the entire development and production of the equipment. On that tiny volcanic spot, GCA was dragged through the surf on D- plus 13 and in the shadow of Mt. Suribachi the crew, under the ubiquitous Captain Jolley, brought the huge, four-engined, "Dreamboats" down safely when every B-29 crew and plane was desperately needed to push the air attack on Japan.

GCA Manufacture

The GCA project at Radiation Laboratory, M.I.T., was one of the first in which research and production engineers of a private company were asked to assist the Laboratory scientists. The Gilfillan men assisted some thirty-six M.I.T. engineers during 1942 in preparing the first GCA laboratory model for field trials. In the spring of 1943, the Gilfillan engineers returned to the company's laboratories, which comprised over 300 scientists, engineers and assistants during the war.

Gilfillan Brothers were little known east of the Rockies prior to the war. However, the firm was well qualified to accept the important assignment of developing and producing GCA for the Signal Corps and the AAF. Founded in 1912 by S. W. and Jay C. Gilfillan, the organization commenced the manufacture of automotive ignition parts in 1914 and, by natural progression, entered the radio and aviation fields. They are one of the five oldest radio set manufacturers in the United States and were the first to manufacture plastic radio cabinets and one of the few producers of television receivers prior to World War II.

As a result of Gilfillan's success in developing and producing GCA, the company was awarded other radar contracts. The first was for a 28 pound airborne IFF beacon, AN/APN-19, known to the AAF as "Rosebud" and to the RAF as "Buttercup." This beacon doubled the effective range of GCA and aided in identification by greatly increasing the brilliance of the radar blip of the aircraft on the PPI Indicator. The beacon also fulfilled its function as an identification "friend or foe" through the coded response given to the ground station by the transmitter.

Another radar device produced by Gilfillan was a 65 pound paratrooper homing beacon which dropped with an assault group and enabled other friendly troop-carrying planes to pin-point their airborne cargo of personnel and equipment.

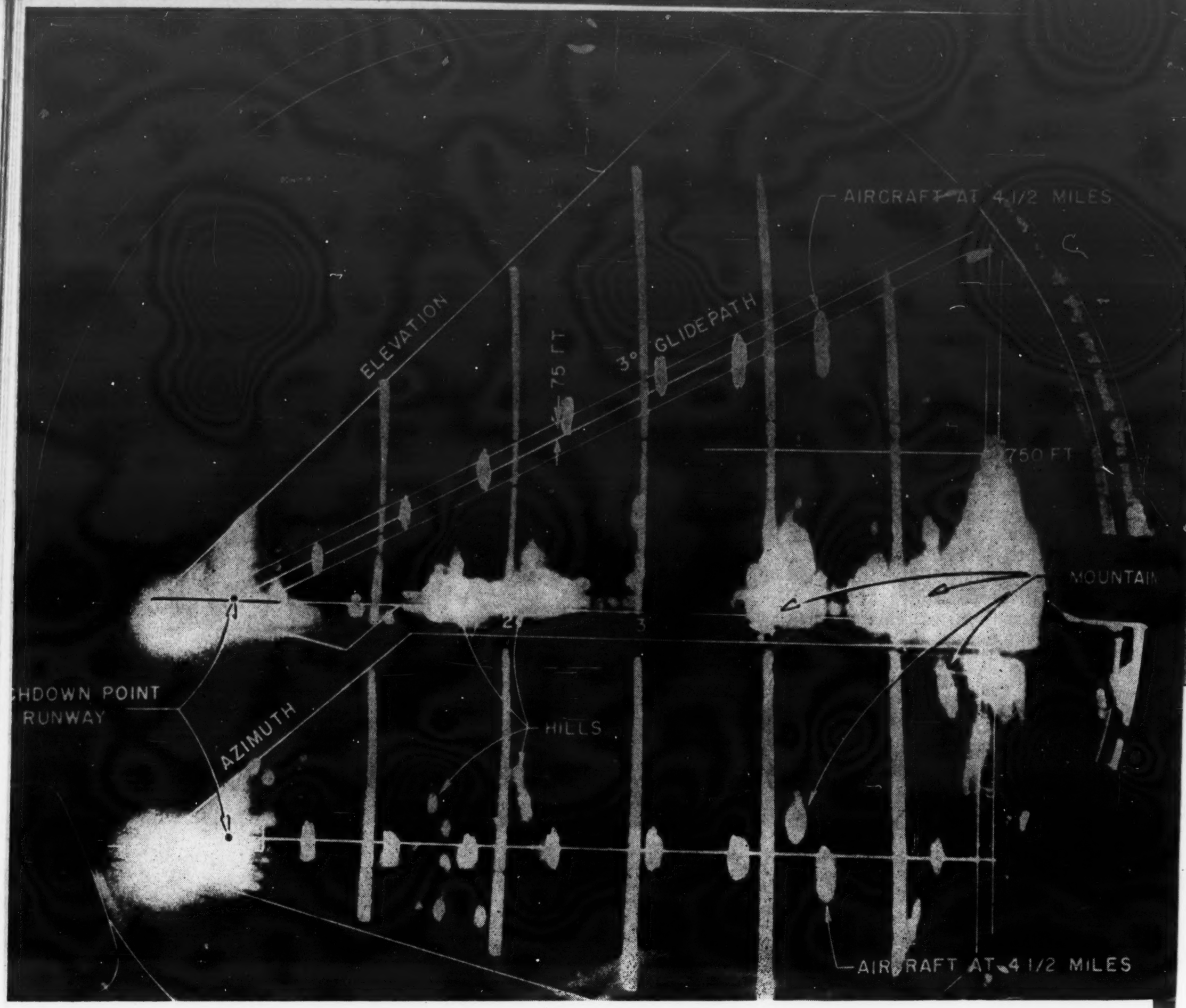
During World War II, Gilfillan Bros. produced over $35,000,000 in military equipment; $20,000,000 in electronic units; and $15,000,000 in aircraft components.

GCA Function

GCA is composed of two separate, functionally independent radar systems, the search and the precision. The search system presents on a cathode-ray plan position indicator (PPI) a polar map giving azimuth and range information on all aircraft and obstacles within an approximate 30-mile radius. With this information, the operator can locate aircraft within the search area and direct them individually to a point approximately ten miles from the approach end of the

Interior of AN-MPN-1 mobile trailer for 5-man crew.

"Pocket-size" console for civil airports.



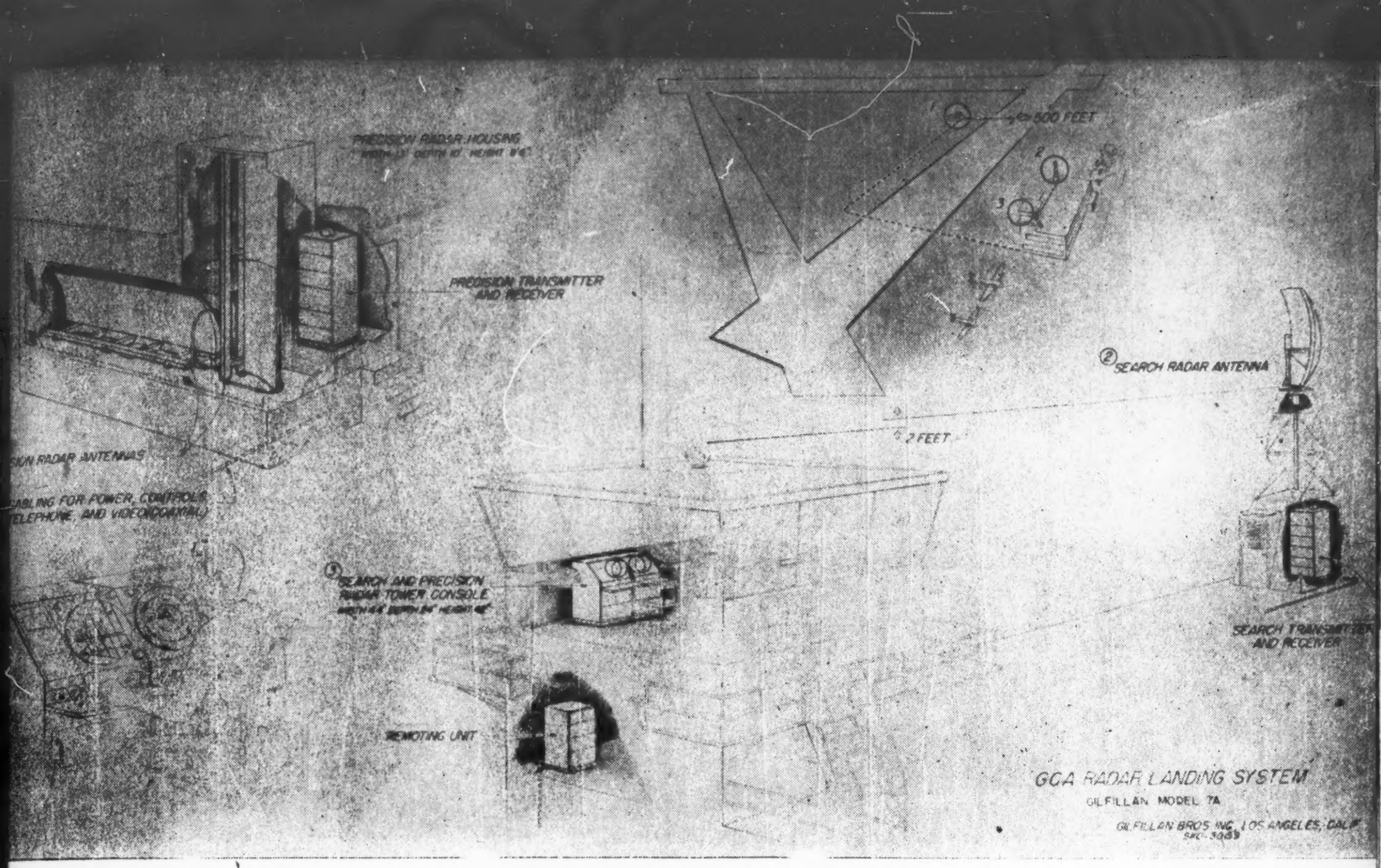
AZEL 3-dimensional scope showing actual landing.

runway. At this point the aircraft appears on the cathode-ray scopes of the precision system. This system presents on two expanded precision indicators (EPI) a triangular radar map giving azimuth and range information and adding thereto the third dimension of elevation. With this three-dimensional data showing the aircraft's precise position within a few feet, the ground operator is able to direct the plane down the prescribed glide path and onto the runway under emergency conditions and even in zero-zero weather.

The information shown on the indicators is relayed to the pilot by a radio communication system. One of the principal advantages of GCA is that no additional equipment is required in the aircraft, thereby enabling the operator to handle any type of plane from a Piper Cub to a four-engine transport or the fastest jet fighter.

Military GCA housed the search and precision radar systems and the communication equipment in a single mobile trailer. Anticipating that no other navigational aids would be available at advanced military bases, GCA was deliberately designed as a self-sufficient navigational aid and the operation was broken down into five separate positions. Two of the operators in the five-man group handled the search radar system. One was a traffic director of large fleets of returning military aircraft and functioned as an Airways Traffic Control operator for all aircraft in the 2800 square mile area shown on the search indicator. The second search operator, with a similar PPI indicator, functioned as a Plane Selector, maneuvering aircraft into a point down wind from the approach end of the runway, where the aircraft was to revert to the precision crew for the final approach and landing.

Inasmuch as the complexity of the final approach and landing of large groups of aircraft was an unknown factor, this function of the GCA unit was divided among three operators. One, an elevation tracker, and the other, an azimuth tracker, kept mechanical cursors constantly aligned with the radar blip appearing on their precision indicators by means of hand cranks. This mechanical tracking activated meters appearing before the Final Controller, giving him the deviation of the



Commercial GCA System for civil airport use.

aircraft to the right or left of the approach course as well as height above and below the proper glide path. This Final Controller, by relaying the information thus presented to the pilot, was able to direct him to an approach and landing.

GCA Improvement

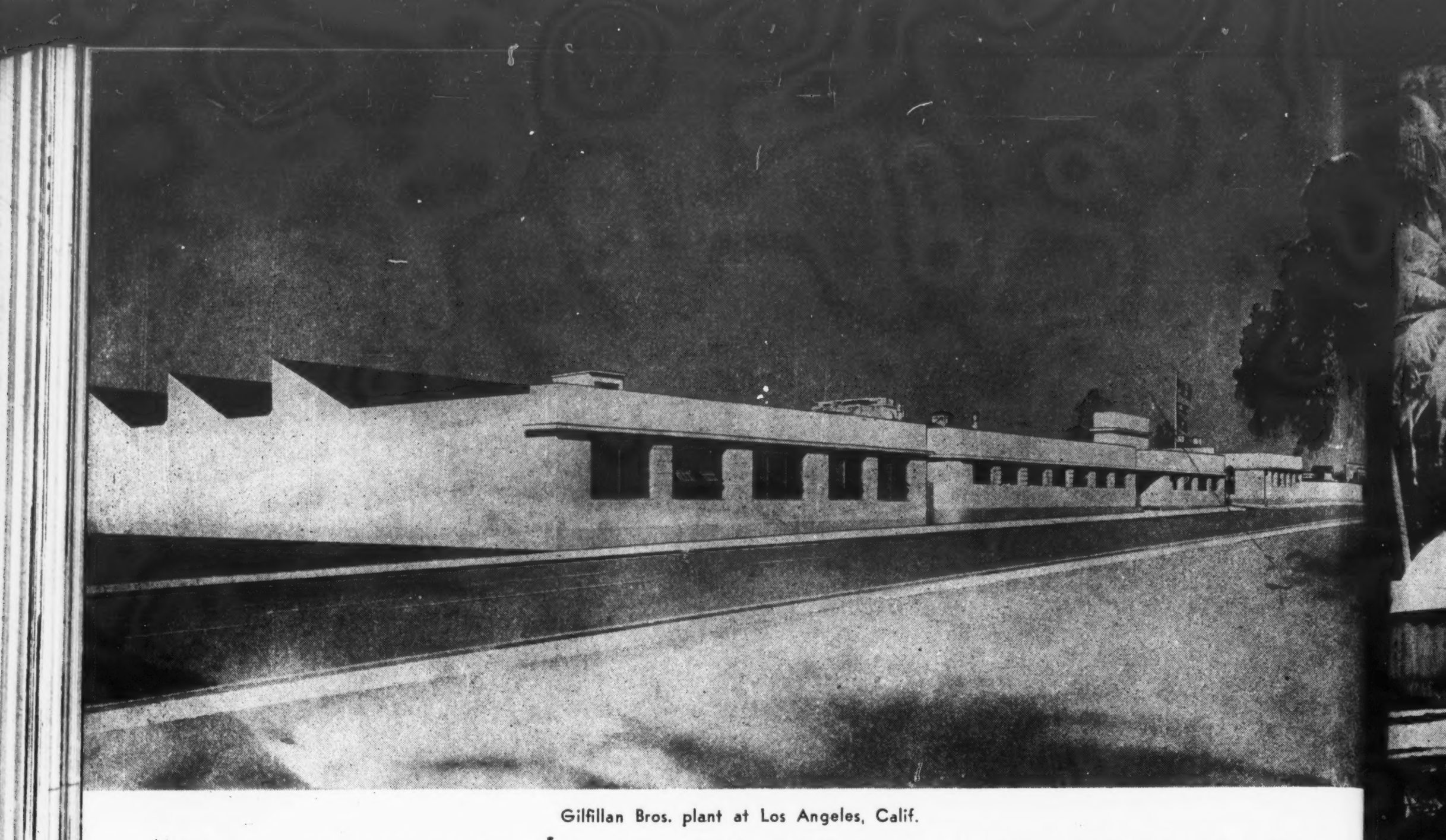
In 1944, Gilfillan was awarded additional development contracts by the Army and the Navy for the improvement and simplification of GCA equipment. These improvements have included direct scope reading (elimination of the hand tracking), reduction in number of operators, additional range, greater definition, enlargement of the indicator scopes from 7 inches to 12 inches, fast-time constant which overcame interference from rain and snow and also eliminated a large part of the difficulty presented by excessive ground clutter.

The improved version of GCA developed by Gilfillan for the Navy, designated as AN/MPN-3, reduced the weight from 44,000 pounds to 12,000 pounds, reduced the number of scopes from six to four and the number of operators from five to three. This unit is now undergoing tests at the Navy Research Laboratory at Charlestown, Rhode Island. The four 12 inch scopes in the Navy model include elevation and azimuth indicator which are hand tracked with cursors by two operators and presented on a 12 inch cathode ray indicator known as an error scope enabling the Final Controller to determine the deviation of the aircraft in two dimensions. The PPI search indicator is located above the error scope requiring the final controller to handle the previous functions of the traffic control, the plane selector, as well as the final controller.

The Air Transportable version of GCA designated as AN-CPN-4, which Gilfillan has just completed and delivered to the Army Air Forces, consists of a mobile trailer which can be broken into small sections and transported in a C-47 to forward air bases. This model consists of three separate self-contained GCA units, each with its own communication facilities. Two of the operators have search indicators and precision indicators and the third operator has complete precision indicator data before him. This Air Force model of GCA eliminates the necessity of hand tracking, of cursors and permits the operator to obtain information on the precision system by direct reading of the indicators. The azimuth and elevation scopes have been combined into a single three-dimensional indicator known as azel. This azel scope indicator and the PPI indicator have been built into a small desk-size console measuring 42″ in total width, 42″ in height, and 27″ in depth, and this desk-size console can now be located in the airport control tower by means of coaxial and other remote control cables.

On the Azel scope the three-dimensional information has been achieved by presenting the elevation data in the upper half of the scope showing the profile view of an area six miles out from the end of the runway. The lower half of the scope presents the azimuth view of the same approach course to the runway, as if the observer were directly above the six-mile area approaching the touchdown point on the runway. When the aircraft enters the precision beam of the scope, the plane appears as two blips of light, one in the upper half of the scope showing its exact elevation and range, and in the lower half the aircraft appears at the same range or distance from the touchdown point on the runway and its precise azimuth position, right or left of the approach course to the runway.

The Azel scope console and the search scope console were devel-



Gilfillan Bros. plant at Los Angeles, Calif.

oped and produced for the AN/CPN-4 air-transportable GCA model. As a part of the joint effort to install GCA immediately at New York, Washington and Chicago, the AAF Air Materiel Command agreed to loan these consoles to the CAA. As an interim measure, three AN/MPN-1 GCA mobile trailers were brought up to 1947 operating efficiency by the installation of a number of improvement kits which were developed for the AAF during the war, and the information ordinarily presented on the six scopes in the trailer was remoted by coaxial cable to the two scopes in the Azel and Search console in the airport control tower. In addition, through the use of additional remote cabling, the adjustments and controls ordinarily accomplished in the trailer may be handled by the operator in the control tower.

Commercial Models

The commercial model of GCA, termed the Gilfillan Radar Landing System, will consist of the same two-scope console in the control tower. Only the Precision Antennas, however, will be located on the field. The Search System will be located on or adjacent to the roof of the control tower. This reduces the amount of equipment on the field to a minimum, and enables additional runways to be equipped for final approaches and landings at minimum cost. This ability to equip additional runways inexpensively is but another evidence of GCA's flexibility. In the event of increased traffic density, all that is required is the addition of another desk-size console in the control tower.

Automatic GCA

Indications of the potentialities of GCA is the latest development being conducted by Gilfillan for Watson Laboratories, the research center of the AAF, Air Materiel Command. This improvement kit is expected to be test-flown by November 1947, consisting essentially of a formal unit to accomplish automatic GCA approaches and landings. Through this development, GCA will have progressively decreased the number of operators required from five to three, to one, to none. The unit is expected to weigh approximately 75 pounds and contains about 25 tubes and three small servos may be added to the AN/MPN-1 trailer or to the new AN/CPN-4 equipment and permit GCA to land planes equipped with automatic pilots without human control.

GCA will then be the only landing system able to furnish assistance to all of the following types of equipment: aircraft equipped with automatic pilots; aircraft equipped with ILS cross-pointer meters, which can be furnished visual information in the event the pilot desires this data unassisted by ground controllers; aircraft not equipped with landing aids, and those whose landing aids are mal-functioning, which can be landed by the normal talk-down procedure with the control tower operators utilizing the regular GCA scopes.

Maintenance

One objection that has been raised to GCA is excessive maintenance. Official records of the AAF prove that GCA is surprisingly free from maintenance trouble. Under AAF contract, Gilfillan obtained civilians to operate equipment in Japan—in snow drifts and tropical heat. Except for the customary two-hour daily preventive maintenance, the units have required an average of less than two hours per week of repairs.

Of the three billion dollars expended during World War II on radar, GCA is one of the few radar devices with an immediate peacetime application. The war-proven equipment promises to bring the aviation industry to a point where it will become a year-round, dependable mode of transportation, instead of a weather controlled gamble.

Melbourne To Tokyo

By Lt. Col. D. W. Eddy, Signal Corps

THE PACIFIC OCEAN is fantastically large, spread across more than 63,985,000 square miles of earth's surface. From Melbourne to Tokyo by a Great Circle path is about 5,000 statute miles; from Melbourne to San Francisco is 8,000 miles. Sporadically scattered across this great sea are innumerable small atolls and coral reefs—tropical islands reeking with fetid jungle growth, myriad insects and animals. Strangely exotic and richly euphonious names abound in these regions: Palmyra, Ponape, Ulithi, Guadalcanal, Iwo Jima, Marcus, Lot's Wife.

This was the tremendous arena in which the Japanese War was contested. Across these enormous distances and under unprecedented local conditions the Signal Corps was charged with the communications responsibility.

December 7, 1941 found an Army troop convoy in the Pacific, one week out of Honolulu, bound for Manila. The units were largely composed of infantry and artillery personnel—destined to form the nucleus of the forces that were later to fight their way back to the Philippines and into the southernmost islands of the Japanese homeland. Included in the convoy were some Signal Corps units and casual personnel, the advance guard of Pacific communications.

The convoy reached Brisbane, Australia on 23 December and disembarked part of the troops. The remainder of the ships steamed northward and eventually unloaded at Darwin, on the desolate northern coast. Operations were immediately begun to establish a port and base, and personnel of the combat units joined with the small cadre of Signal men to install necessary communications.

Lt. Col. Eddy is Executive Officer, Army Communications Service, Office of the Chief Signal Officer. He received a BS in Electrical Engineering from the University of Vermont in 1937 and was an engineer with the Western Union Telegraph Company before the war. Col. Eddy entered active duty in November 1940 and was with Headquarters, U. S. Forces in Australia from March 1942 until July 1943. He became Base Signal Officer at Port Moresby, New Guinea in 1943, remaining until November 1944. From that date until December 1946 he was with AFWESPAC, in the Philippines and Japan.

First Phases

With little equipment available, it became necessary to depend almost entirely on existing facilities for communication between the bases at Brisbane and Darwin, and the United States. The Australian Armed Forces, including the Army, Navy and Air Force, were extremely co-

Signal operations in the Pacific were plagued by vast distances, mud, jungle, fungi and omnivorous ants

operative. For many months the majority of U. S. Army traffic was handled over Australian Armed Force, or commercial facilities. Even codes and cyphers were supplied by the Australians. U. S. Army officers were trained in the use of these codes and cyphers to lighten the burden on the Aussies.

With the fall of the Philippines, some Air Force units were evacuated with their planes and established bases in Northern Australia and in Java. These forces consisted of the remnants of the 19th and 7th Bombardment Groups, eulogized in such books as "Queens Die Proudly" by W. L. White and "My Fighting Congregation" by Chaplain W. C. Taggart. The Air Force troops which had withdrawn from the Philippines to Java required ground support in order to continue offensive missions against the Japanese. Consequently, some of the personnel in Australia were sent forward to Java. Other troops from Australia travelled to Java with the mission of providing all possible relief to General MacArthur through blockade running in small boats and ships.

Java's internal communications facilities are fairly well developed and little difficulty was encountered in arranging with the Dutch for wire communication to link the scattered U. S. Air Forces deployed on the island, with headquarters at Bandoeng. Many a man, however, tore his hair in an effort to talk on a common basis with a Dutch or Javanese telephone operator. For communication to Australia and other points, we fell back again on our friends, the Aussies, and set up radio circuits using their equipment. The U. S. Navy was a further source of assistance during this period.

The establishment of adequate bases in Java had barely begun when the Jap drive through the Java Sea made the evacuation of the island by U. S. Forces necessary. Orders were received to evacuate with the forces splitting between India and Australia. Elements of the 131st FA Bn, which had provided logistic and ground support to AF units and furnished much of the communication personnel for the island, were left behind for almost inevitable capture by the Japs.

Reinforcement

Meanwhile, the forces in Australia had been augmented by additional troops from the United States. By March 1942 the theater had a Signal battalion, the 52nd. Bases were being operated in Brisbane, Townsville, Darwin, with others at Perth, Adelaide and Sydney soon to follow. United States Army Forces in Australia, controlling these bases, had established a headquarters in Melbourne and it was from

Pacific communications faced unprecedented operating conditions.

here that the task of providing communications from "Melbourne to Tokyo" really began to gather momentum.

With a population of about 7,000,000 roughly equal to that of New York City, and a land area slightly less than that of the continental United States, Australia is hardly a densely inhabited continent. The majority of the population is centered in a long coastal strip which includes the major cities of Perth, Adelaide, Melbourne, Sydney and Brisbane. Sydney alone accounts for about 1,400,000 of the total inhabitants. The interior, or "Bush Country" of the continent is extensive and exceedingly arid.

Among the unusual developments by Signal personnel in Australia was communications facilities for General MacArthur's special train. To reach all points in Australia, it was necessary to travel on four different track gauges. As a solution it was decided to confine operation of the train to the states of Victoria, New South Wales, and Queensland. Consequently, three separate trains were provided, one for use in each state. This arrangement enabled the General to travel by special train from Melbourne to connecting points in each of the three states. Several cars in each of these trains were designated for installation of signal communication equipment. This equipment consisted of a radio station complete with power and crytographic devices, as well as telephone and teletype units for use on land wire lines. The radio station was operated in a point-to-point CW net and the use of telephone and teletype equipment contemplated the connection to suitable and convenient land-line facilities at locations where the train halted. Upon receipt of itinerary it proved possible, in practice, to connect these land lines with a minimum of delay through execution of prearranged plans.

P.M.G.

The Postmaster General's Department, which controls communications in Australia, tackled the task of furnishing the ever increasing requirements of the U. S. Forces. Civilian facilities were drastically cut and equipment and personnel were shifted to meet military needs. Equipment of practically all types was in short supply and the problems presented often seemed insoluble. Arrangements were made for the PMG to receive lease-lend equipment from the United States, but the actual delivery was indefinite.

These Aussie pigeoneers processed birds for American patrols.

From both defensive and offensive viewpoints the northern extremities of Australia were becoming increasingly critical. Darwin, Cape York, and Townsville became the forward locations of airfields and ports. These three sites form a triangle on the map. Between Townsville and Darwin and Cape York were many miles of arid "bush" country and little else. The Gulf of Carpenteria generally separates Darwin and Cape York.

To further the development of these installations and permit land-line communication between the three, and to headquarters farther south in Australia, an extensive and ambitious plan of signal construction was prepared and begun in conjunction with the PMG.

In order to implement the construction plan it was decided to employ two heavy signal construction battalions (aviation), shortly scheduled to arrive from the United States. Inasmuch as the majority of material would have to be obtained in Australia and because routes, for the most part, would be along and supplemental to existing Australian plant, it was considered advisable to utilize Australian type construction. The necessary orders were placed for material and upon receipt its movement to the desired locations was commenced.

The first route to be augmented was an existing circuit over the 900-odd miles between Townsville and Cape York. For the majority of the distance the existing facilities consisted of one iron telegraph wire on steel poles of various types.

Upon arrival in Australia the two Signal battalions commenced training for the type of construction which would be required. This method was, in many ways, different than that for which the troops had originally been trained. This difference is dictated by both the geography and the economy of the continent. In Northern Queensland, where the first construction was to take place, timber is relatively plentiful in some locations and some species are suitable for wooden poles. Also found in North Queensland is a particularly voracious type of ant which apparently likes nothing better than to digest telegraph poles. One Signal Corps officer wrote home that after experiments with wooden poles "all we found were the glass insula-

tors, wires, bolts and braces and the empty holes."

The wet season has such a detrimental effect on wooden poles in Australia that they are actually fitted with small individual tin roofs. To overcome these difficulties iron poles are very extensively utilized and about five types of iron poles were considered as standard. These consisted of various sizes of iron pipe, railroad rails, "eye" beams and several types of tapered steel poles. Considerable experience was required to become familiar with the hardware specified for each type of pole. The tapered pole was particularly difficult because it required different size hardware for each crossarm. The "through bolt" method of attaching crossarms to poles, commonly employed in the United States, is not extensively used in iron pole construction in Australia and the arms are attached to the poles by arm plates and back plates. Also known as plates are slab-shaped pieces of iron or steel placed in the ground. These were butt, side or end plates, depending respectively on whether they were used under, beside, in front of, or behind the pole. A generous assortment of washers, nuts and bolts also accompanied the assembly. Troops had to be thoroughly familiarized with this strange equipment.

"Burning the Pole"

It was generally believed that the wooden poles would be too hard for spur climbers but at the expense of "burning a few" the linemen soon learned how to get along although forced to resort to the much scorned ladder when working on iron poles. To enable working on iron poles it was necessary to have a large quantity of ladders manufactured for issue to the battalions.

When the troops had been trained and moved to convenient locations, the projects were begun. The battalions were deployed over the route of construction and were allotted specific sections of line. Competition between the units was encouraged. An Australian Army Signal group was also allotted a section of line. A few PMG supervisors were assigned to each battalion to assist in technical matters pertaining to construction, in accordance with PMG specifications.

One of the greatest difficulties encountered was logistic support of the battalions. The supply line was considerably extended because most of the metal materials were being manufactured in southern Australia and usually were completed only in sufficient time for immediate shipment, which was primarily by rail. From Melbourne to Townsville there were two changes in railroad gauges and this required duplicate loading and unloading operations. Shipments had a distressing habit of becoming lost at the transfer points. The locomotives on the Queensland narrow gauge railway were small and all too often stalled and had to drop a few cars. When this happened a car or two of pole line material usually managed to be included. Theoretically these cars would be picked up by the next train that could handle them but in practice it was usually necessary to ride the line until the car was located and then arrange for a priority pickup. To add to the difficulties the roads along the pole line were practically non-existent and the hauling of material and other supplies was a continuous and severe task for the battalions. Bulldozers were issued to each battalion to enable them to make temporary roads. Portable refrigerator trailers made it possible to reduce ration trips.

The work between Townsville and Cape York was completed in record time and the battalions went on to build a line from the Queensland railhead at Mt. Isa to the spur running between Adelaide and Darwin. By addition to facilities on existing lines at both ends, this completed the link between Townsville and Darwin, a distance of about 1100 miles, approximately 250 miles of which was new construction. By the time the existing routes between Brisbane and Townsville had been augmented the northern and the southern portions of Australia had been well linked by wire construction.

Field switchboard in Leyte invasion. Ormoc, 1944.

Guinea Operations

During the development of Northern Australia, progress had

also been made in New Guinea. A small base had been established at Port Moresby and the construction of airfields was commenced. These fields were used primarily for intermediate fueling points for bombers and for fighter plane bases. The Japs had landed on the eastern coast of New Guinea and were repulsed in their attempt to cross into Port Moresby on the Kokoda Trail of the Owen Stanley Range.

New Guinea presented altogether new and different problems to the men of the Signal Corps. The island had been very sparsely developed during peacetime and the terrain was principally jungle and mountains with continual very high humidity. Runing from northwest to southeast, the Owen Stanley Mountains range from 7,500 to about 18,000 feet. Port Moresby was the island's largest settlement and the seat of the Australian mandated Papuan government. It was hardly more than a hamlet with a few trading warehouses and one large pier for ocean-going vessels.

The fighting along the Kokoda Trail was hard on both men and equipment. The only way to get over the terrain was by foot and that is where the New Guinea natives played an important role in the island campaign. Although small and seemingly weak and undernourished, the Papuans are actually wiry individuals with amazing strength and agility. Both men and women were utilized as bearers to transport food, supplies and equipment to troops on the Trail. On the return trip they carried the wounded in stretchers and were surprisingly gentle and careful in winding their way over the rough ground and through the inevitable mud and ooze. In the heights of the Owen Stanleys hardly a day passed without rain and this made it extremely difficult to maintain contact with field forces.

The Guinea natives made their "pin money" during those days by capturing stray Japs. The ANGAU (Australian, New Guinea Administrative Unit), which controlled the natives, paid a bounty for each Jap prisoner delivered alive. It was not unusual to see a Jap brought into Port Moresby, strung up like a pig and carried on a pole between the shoulders of two Papuans.

Maj. Gen. Akin, (right), and Lt. Gen. Sutherland, Chief of Staff, are decorated by Australian Army.

Jungle Difficulties

Walkie-talkies of the infantry proved of little use in the thick jungle of the range and it was usually necessary to rely on field wire for communication. Air-ground contact proved particularly difficult during this period. Even the W-110 Field Wire was difficult to maintain and a substitute Australian wire was extensively used.

During the fighting along the Trail, the base at Moresby was steadily growing. The Signal Corps erected an increasing amount of fixed plant. Lead cable, mostly of Australian manufacture, was installed on native poles to serve the airfields and units dispersed throughout the area. Open wire construction, as well as rubber cable, was also employed. A fixed radio station provided communications back to the Australian mainland. Warehouses for a signal depot gradually arose from the Guinea mud.

During the early phases of the war in the Southwest Pacific considerable reliance was placed on Australian materials since most of the Signal equipment manufactured in the United States was being ear-marked for the forces in England and Africa. Some of the Australian equipment was designed and built for the Australian Army and the remainder was manufactured exclusively for the U. S. troops. The principal items obtained were radio transmitters and receivers and pole line construction components. Radar units were also procured and operated.

As the Japs were pushed back the war in New Guinea moved across the Owen Stanleys to the east: toward Oro Bay and Lae. Eventually, bases were established at these locations and the expansive valley of the Markham River, leading inland from Lae, was used for the construction of forward air bases.

(In the next issue of SIGNALS *Col. Eddy traces the communications story through the Philippines to Japan).*

Two SCEL radars tracking flight of V-2 rocket at White Sands.

IMPLEMENTING THE VICTORY

By Harold B. Churchill
Major (Sig. Res.)

S. C. E. L. Research was a vital factor in dynamic warfare

WHILE WARTIME engineering facilities of the Signal Corps, in concert with the country's leading electronic manufacturers, were speeding the research and development of radio, radar, wire and other equipment in a race for battlefield supremacy, the science of sound ranging was under intensive study to establish the exact position of enemy gun emplacements for increased effectiveness of counter-battery fire.

Despite very limited personnel in the latter 1930's, the Signal Corps Engineering Laboratories had made major progress in the development of Sound Ranging Set GR-3-C. This unit in its final form became an almost entirely automatic device which, simply on the closing of a switch by an outpost observer, produced a photographic record completely developed and fixed, showing the arrival time of the sound wave at each microphone. From these arrival times and the location of the microphones, the position of the sound source was quickly computed. The development of this type of equipment, along with improved microphones, furnished an extremely useful sound detecting and locating device for Field Artillery surveillance.

To exploit this instrumentation to its best advantage, intensive investigations were conducted from 1939 to 1944 to evaluate the atmospheric effect on sound propagation. The first result was the introduction of a plane array of sound microphones, replacing the conventional line array or straight base. Intensive experimental work in sound propagation disclosed the existence of a definite correlation between weather depicted on a surface map and the accuracy of sound locations—to the extent that sound-ranging weather could be classified as "good," "poor," or "bad." And these investigations disclosed another fact: there was no evident relation between the muzzle-blast frequency of an artillery piece at tactical ranges and the calibre of the piece.

During the latter stages of the war, particularly in operations against the Japanese, these sound-ranging techniques were effectively used by the Infantry against small arms and mortars, through the deployment of an array of microphones in a 15-foot isosceles right triangle, coordinated with similar nearby installations to establish a highly accurate fix.

This primary wartime use of sound ranging equipment to locate enemy targets brought with it new knowledge of meteorlogical effects upon sound propagation which are invaluable for other purposes. For instance, if the exact locations of a sound source and detecting microphones are known and the total time of travel is determined, the meteorological structure of the atmosphere may be deduced from the arrival time of the sound wave at the several microphones.

During recent ammunition explosions under the auspices of the Army-Navy Munitions Safety Board at Arco Proving Grounds, Arco, Idaho, SCEL's microphones were set up at distances from 120 to 400 miles from the explosion site. At one location, Green River, Wyoming, the sound was recorded as four separate arrivals over a period of 112 seconds by a triangular array of microphones four miles apart, leading to the conclusion that the sound was propagated to a height of 110 kilometers, or 70 miles above sea level.

Still another important phase of this upper atmosphere investigation is the use of V-2 rockets to expel sound, flash and smoke charges at high elevations. By spotting the position of the bursts by phototheodolites and evaluating the difference in arrival time between two successive explosions, it is possible to calculate the velocity of sound over this height interval, and, provided the atmosphere's constituents at these levels are known, to evaluate the temperature at these heights.

Thus sound propagation phenomena, initially studied by the Signal Corps for counter-fire purposes, has evolved

into a major instrument for atmosphere study.

Photographic

In few other fields does American productive enterprise, operating closely with the Signal Corps, deserve more credit than for the joint endeavor which enabled the wartime Army Pictorial Service to produce combat film footage running well into eight figures: documented historical records, disseminated news, permitted technical study of new weapons, and provided a highly effective medium for strategic and tactical planning. This, in addition to the photographing of over a billion V-mail letters.

The U. S. entry into World War II, the best-photographed conflict in history, brought unprecedented demands for photographic equipment, necessitating at the start almost sole reliance upon material designed for civilian use.

The problem presented to the Pictorial Engineering and Research Laboratory Division of APS at its conception in 1943 was first to adapt large quantities of existing equipment to rigorous battlefield conditions with no peacetime parallel, and concurrently to investigate, design and develop new combat and non-combat military devices. Simultaneously, PERL began to write procurement specifications, technical literature covering operation and maintenance, and to conduct intensive tests of procurements, while coordination was set up with other services through the War Committee on Photography and with industry through the American Standards Association.

The results of cooperative effort between industry and Signal Corps soon produced a flow of equipments particularly fitted to combat requirements. Changes in Motion Picture Camera PH-330, for instance, resulted in simplification, more convenient operation, and versatility. Development produced a relieved aperture plate, hand trigger release, improved winding key, behind-the-lens filter slots, and anti-reflection coated lenses. A variable focus view-finder, the PH-532/UF was developed. Mounted on the door of this camera, it provided a single optical system capable of instantaneous adjustment to match the field of view of lenses from 25 mm. to 250 mm. This single modified camera was to later become the basic Signal Corps equipment which accounted for over 90% of all U. S. combat footage shot during the war.

Other developments produced the PH-530/PF Cunningham Combat Camera, an entirely new piece of motion picture equipment weighing a scant 16 pounds with a full lens complement. Providing lenses of four different focal lengths, instantly terchangeable and sealed against dust, moisture and fungus, the camera contained its own electric drive motor operated by light-weight dry batteries. Using gun-stock construction, and hand grips, it was fired from the shoulder in the same way as a rifle or carbine. In addition to these photo equipments were a notable series widely used through all theaters and including Cameras PH-501/PF, PH-530/PF, and many others in addition to laboratory darkrooms, developers, projection boxes, immersion heaters, mountings, and tripods—representing over 1000 completed PERL projects.

With the war's end, PERL was reorganized and merged with the Signal Corps Engineering Laboratories where photographic research and development are now incorporating the knowledge and experience gained during hostilities. One concentrated point of current endeavor is a program of *winterization techniques* for still and motion picture cameras, all-important for operations in Arctic or other northern climates where pictorial records will become items of first necessity in the event of a subsequent conflict. As this winterization data accrues it is used as a basis of maintaining TB Sig 189, "Cold Weather Photography," on an up-to-the-minute status.

Meantime while SCEL's photographic engineers study winterization and continue developments, a large number of captured enemy devices are under intensive scrutiny to combine their best features with those of U. S. equipment.

Power Units and Batteries

While wartime developments were proceeding in other fields, power unit and battery development was geared to keep pace with using equipments. One gauge of this progress was the average power unit weight before the war of 223 pounds per kilowatt which wartime development pared to 134 pounds per kw., a reduction of 40%.

Bulk was also sliced. Starting at a prewar 5.63 cubic feet-per-kilowatt, hostilities' end saw compact Signal Corps units producing a thousand watts within an average cubage of 3.9 feet.

Prior to U. S. entry into the war, progress had been made on the first phase of the power unit development program: the test of available engines under military field conditions. Among other findings, these tests showed four-stroke cycle engines failed to operate satisfactorily for a reasonable time with constant load at a constant speed when using available military gasoline. Development, however, modified valves, valve guides, and valve seats which resulted in lengthening the full-load operating period to an average of 400 hours. Work was also undertaken on the two-stroke cycle engine which, while not affected as extensively by military fuel, was retarded by the mandatory use of detergent oil which caused rapid port clogging and spark plug fouling. By changing port locations and other features plus the addition of spark plug adapters, the port and spark plug cleaning period was extended to 50-odd hours, while mechanical design was modified to make service operations simple, sure, and fast.

Improved power unit regulation was also an object of attack. Cheap, precision mechanical governors were evolved which controlled output frequency within 2 cycles from no-load to full-load, and to less than 0.2 cycles at a fixed load; voltage regulators were produced which held voltages virtually constant regardless of load. These devices were greatly reduced in size, weight and cost.

While these were a few of the wartime power unit developments produced in cooperation with manufacturers, continuing Signal Corps development aims at a standard family of power units composed of six basic engines and 18 generators with a maximum of interchangeable parts, and minimum parts-per-engine. Generators for 60 and 400 cycle as well as DC output would thus provide power from 150 watts to 15 kilowatts in six progressive classes. This standard family is expected to result in uniform, lightweight, compact, rugged units capable of immediate mass production by several manufacturers should the need ever arise.

Capacitors are given 75,000-volt dieleetric strength test.

As a power source for light, highly portable and lower-powered signal equipments, battery development was well under way by the fall of 1941, tackling a series of problems peculiar to units initially designed for civilian use in the temperate U. S. climate. Tactical requirements called for their distribution on a world-wide basis and operation in either a tropical jungle which caused rapid decomposition, or in north European sub-zero cold which reduced available voltages far below a usable value. While the first problem rendered cells virtually useless, the second might have brought on mass set failures.

SCEL's battery development sections, with all-out cooperation of industry, undertook to solve these complex chemical and physical problems.

One result was the evolution of a family of cold-temperature dry cell batteries which maintained good performance down to forty degrees below zero, fahrenheit, and were interchangeable both physically and in potential with temperate climate batteries of the series.

Second, the shelf-life of dry cell batteries was lengthened to the point where it was possible to ship cells to remote points, store them under adverse conditions, and operate them more satisfactorily despite tropical heat. New moisture-tight barrier materials for packing eliminated the need for special handling, permitting safe outdoor storage in extreme moisture.

A further product of wartime development was the RM cell which, containing mercuric oxide in addition to zinc and potassium hydroxide, was inclosed in a hermetically sealed con-

Experimental hydrogen thyratron in processing at SCEL.

tainer and was capable of withstanding storage at 130°F for extremely long periods with no apparent loss in capacity. Compared to conventional cells, the RM had in addition a flat discharge rate, high operating efficiency, and higher capacity per unit. RM production was well under way by September 1943, with an initial delivery of seventeen million units within six months for tactical man-carried equipments such as the SCR-300, SCR-536 and SCR-511.

In portable storage batteries, development produced a complete line of military non-spill, plastic case units incorporating low temperature capacity and other features never before available in storage batteries.

Quartz Crystals

Most modern radio sets designed for fast-moving operations incorporated crystal control for rapid positive netting and unmistakable frequency checks. To equip radio sets, in some cases delivered with a complement of 120 crystals, required in effect the creation of a new industry in the formation of which the relatively few prewar crystal producers joined with the Signal Corps in the pooling of knowledge, the development of mass production techniques, and the instruction of new manufacturers.

A school was set up in which personnel from crystal manufacturing plants were trained; engineers were dispatched to Brazil to explore mining facilities and expedite shipments; and the Treasury Department, The War Production Board, and the Bureau of Standards, made major contributions to the problem of procuring enough quartz of adequate quality from Brazil. Concurrently, research on quartz crystal substitutes was pushed.

Standardization reduced the 70-odd types of crystal test sets in use to 4, while consolidation of specifications reduced 20 separate types to a single type under one specification. So crystals could be ground on the spot in combat theaters to meet changing tactical needs, field grinding team equipment AN/FSM-1 was designed and produced, and some 15 operating teams were trained and shipped overseas. A single war-year's production figures are highly impressive: 36,000,000 discs—three hundred times the prewar rate.

Thermionics

The widespread use of vacuum tubes for communications, radar, proximity fuzes, counter-measures, direction finding, and numerous other war devices soon brought annual volume production well into the four hundred million bracket.

Almost all of the wartime research and development on tubes was done by major commercial firms and university laboratories. Close liaison existed between Navy, Signal Corps, and Air Forces. Universities operating under NDRC contracts, such as Columbia, Radiation Laboratory of MIT, and Harvard, provided an interflow of data accelerating tube development and, more important, speeded the translation of research into production of new-type electronic weapons for communications, radar, identification, countermeasures and wholly new departures in signalling. Coordination with all interested agencies was accomplished through the invaluable operations of the Vacuum Tube Development Committee.

How important certain new-type electronic devices were for military use is shown by their slice of war tube dollar volume of which three quarters of the total went solely for non-receiving type tubes, a sixty-times increase over any prewar figure.

The difficult task of drafting procurement specifications for these highly intricate and special purpose tubes, sometimes hardly dry from the research laboratory, was possible only by the cooperative action of the industry-sponsored Joint Electron Tube Engineering Council, and the Joint Army-Navy Committee on Electron Tubes. But the success of the war tube program was first and last due to the engineering and production know-how of the U. S. tube industry which performed hitherto impossible production feats as standard procedure.

Some noteworthy tube progress was made by the small but closely-knit tube group working in the Signal Corps' own laboratories. Basic work was carried out, for instance, on the first Signal Corps T-R tube (the GA-4 in the SCR-270 and SCR-271), the VT-158, and megawatt hydrogen thyratrons. The SCEL's tube engineers had another big job: analyzing and separating tube faults from those stemming from other parts of search, detection, countermeasures and signalling devices. Tens of thousands of faulty tubes and reports of failures came directly to SCEL from combat theaters for investigation and necessary corrective action.

Other Important Fields

Other phases of Signal Corps research and development were equally important and cannot be given adequate treatment in this article. There were, for instance, all-important developments by the Army Communications Service, using radio teletype over long haul circuits, of such significance that war's end saw the greatest portion of traffic handled on an automatic printing basis; there were multipurpose facsimile advances, and vehicular developments which produced a standardized series of specialized, highly mobile, self-complete radio and radar units. There was far-reaching progress in countermeasures, advanced heat detection, mine detection, propagation studies and ionosphere predictions—all these merit detailed examination as scientific advances of first-rate importance, not possible in this brief review.

Production Engineering

While the early and middle phases of the war saw major emphasis upon round-the-clock design and development, major emphasis later centered upon production engineering for the mass manufacture of ground signal equipment for the invasion of the European continent in 1944 and subsequent Pacific operations.

This production engineering furnished procurement data and provided technical control over the production of millions of tons of radio, radar, wire and associated devices, placing a floor under operating quality at maximum mass production.

Signal Corps quality control of production operated through the four broad channels of specifications, inspection, maintenance, and equipment improvement. These in turn controlled equipment drawings and tolerances, tested and approved pre-production and production samples, guided pilot runs, set up standard inspection procedures, assisted manufacturers throughout production, provided maintenance planning, and coordinated field performance reports, translating them into production improvements.

To supply increased engineering aid, specially-trained engineers were permanently stationed at the various Inspection Zones and Procurement Districts, establishing direct channels for immediate investigation of production engineering difficulties, often resulting in the analysis and solution of problems in a few hours. Production engineering, working closely with Army-Navy Electronics Standards Agency, further screened thousands of resistor, fixed capacitor and inductor types, resulting in a consolidation and wholesale reduction of items.

Production specifications ranged from the basically simple, covering nuts or bolts, to the highly complex, specifying a complete high-power mobile broadcasting station, all requiring thousands of major wartime specifications, drawings and subsidiary planning.

One phase of production engineering which paid off in output totals was performed by groups which made intensive studies of components and materials to improve existing products and circumvent critical shortages. By one production change alone, substitution of plywood for the aluminum SCR-211 case, 500,000 pounds of aluminum were saved at a time when the metal was critically needed for B-17 mass production. Similar development to conserve mica resulted in high dielectric constant ceramics, and much progress toward artificial mica.

These same groups devised the tropicalization treatment universally used throughout the war and now effected by Joint Army-Navy specifications, and provided the research resulting

Engineer examines horizontal and vertical resolving power of lens.

in component part miniaturization, increased ruggedness and standardization. A direct result of this testing, analyzing and engineering work was standardization of over 45 Joint Army and Navy and a dozen Signal Corps specifications covering resistors, capacitors, ceramics, plastics and electron tubes.

As a further service, maintenance planning activities established uniform repair methods and standards for Signal Depot use, reflected in repair instructions and specifications. These, and the production of parts-lists for all echelons of maintenance, from the operating individual in combat upward, provided the broad technical base for the repair of ground signal equipment during World War II.

Development Detachment

After the first production models rolled off assembly lines, and often in the case of pre-production and laboratory models, another Signal Corps activity went into high gear—the New Equipment Introductory Detachment which later became the ubiquitous Development Detachment, active on virtually all fronts.

Made up of highly trained scientific officers and enlisted personnel, this Detachment put new equipments through their paces in extensive field trials, and tests, and then introduced the equipments directly into the combat zone, instructing troops in their use, performance, maintenance and repair. Returning from the theaters, these detachments brought back a priceless record of combat performance: data on just how each equipment worked, and what changes, if any, were needed. From this, procedures were set up well in advance of mass production deliveries to the field.

Tackling some 105 major projects, the Development Detachment introduced to the field such equipments as the AN/TPL-1, AN/MPG-1, AN/FPG-1, AN/TPS-1, SCR-582, 682, 559, 615, and scores of others. In addition, it introduced in overseas theaters radio relay sets, sound ranging, facsimile, and additional devices. Good linguists as well, Detachment men questioned enemy personnel once projects were finished and brought back invaluable information.

Far from ending with hostilities, SCEL's Development Detachment presently occupies a key position in the Laboratories' functioning. It performs systems tests of combined radar, communications, radio countermeasures and meteorological systems; devises highly important combinations of signal equipments within an integrated system; installs long distance radio relay circuits; and investigates precision local weather forecasting equipments for AGF and AAF. Turning out a first-rate performance at the A-bomb Crossroads test last year when it operated Signal Corps and other equipment, the Detachment has been recently busy with another tough assignment—winterization of signal equipment under subzero conditions.

Future

Development and production for World War II is now history and today Signal Corps engineering emphasis has shifted to a long range research and development program channelled into the nine categories of *thermionics, propagation, circuits, antennas, materials, power sources, meteorology, communications techniques,* and *general physics.* Included in this program is work by the Laboratories of the Signal Corps, but by far the greater proportion is through contracts with universities, foundations, and industry. Totally, some hundred of these contracts are now in effect under Signal Corps administration.

These contracts permit wide latitude and traditional freedom of scientific operations, but the problems assigned aim realistically at concrete military applications of the knowledge gained. As the findings of this basic research flow back to the Signal Corps they are channelled to other services for their information and use in a closely-knit program of technical interchange. Several of the major research studies are in fact joint operations with the Office of Naval Research and AAF's Air Materiel Command—combined explorations across the frontiers of electronics.

Results of this work, already emanating from the nation's universities and commercial laboratories, are by no

means only for military use, but are of major industrial interest.

Electron tubes,—high-power millimeter generators for high definition radar and extremely narrow beam communication are under study and may obsolete many of our present techniques by extending the useful electromagnetic spectrum through microwave radar bands to wavelengths approaching infrared radiation.

Physical properties of known and new semi-conductors for detection, frequency conversion and multiplication, as well as low temperature behavior of super-conductors at microwave frequencies are under scrutiny. The science of sferics is being investigated to extend the accuracy and range of weather networks, as is the propagation of sound, electromagnetic and infrared waves. FM is under examination to obviate limiter circuits, capture effect, and to increase signal-to-noise ratio of weak signals. The growth of synthetic quartz and tourmaline crystals is being pursued to make the U. S. wholly independent of foreign imports.

Artificial weather is also under study. Snowstorms and rainfall are being created by the injection of nuclei into super-saturated clouds, with indications that a single pea-sized pellet of carbon dioxide is capable of producing enough ice nuclei to develop several tons of snow. Rockets sent 100 miles above the earth by Ordnance, with Signal Corps sponsored meteorological apparatus in their warheads, are probing the upper atmosphere to learn hitherto unknown facts about the weather, while lunar radar reflections are resolving unexplained transmission phenomena in space.

This far-ranging program of applied research is the first phase on the Signal Corps' scientific agenda leading to the evolution of equipment based upon the product of research.

Resulting equipment, plus the best devices of World War II, will be available to operate within integrated communications or other systems capable of serving the inevitably fast moving and far more scientific battles of any future war.

Since the Signal Corps has technical responsibility for communications from the War Department to the Division, one of its major objectives is an advanced *theater military signal system* as the high-capacity common carrier of theater communications. A prime requirement of this theater signal system is *integration of equipments* in which modern multichannel radio and wire devices permit trunks of unprecedented traffic handling capacity, carrying the spoken and written word, fixed pictures, television, and a flow of telemetered and control signals for its military subscribers.

And while the Signals Corps' engineering sections tackle the design of terminal devices and common items of equipment to the same technical characteristics—essential to an integrated system, these units are engaged in the equally important evolution of combat electronic equipments so new they were not brought into action in World War II.

Just how rapidly electronic advances will come about in the long term future is exceedingly difficult to predict. But it is certain that this rate will be in *direct proportion* to the efforts expanded upon research and development.

In the interim years between World Wars I and II, for example, the development and procurement of signal equipment was so restricted by inadequate funds that apparatus produced in 1918 had to serve 20 years later, with the result that maneuvers with wooden guns were coordinated by commercial telephone calls in 1942; or the Army's efforts at the development of radar in 1936 when the Signal Corps sought, and failed to obtain, funds less than the procurement cost of a single Radio Set SCR-268.

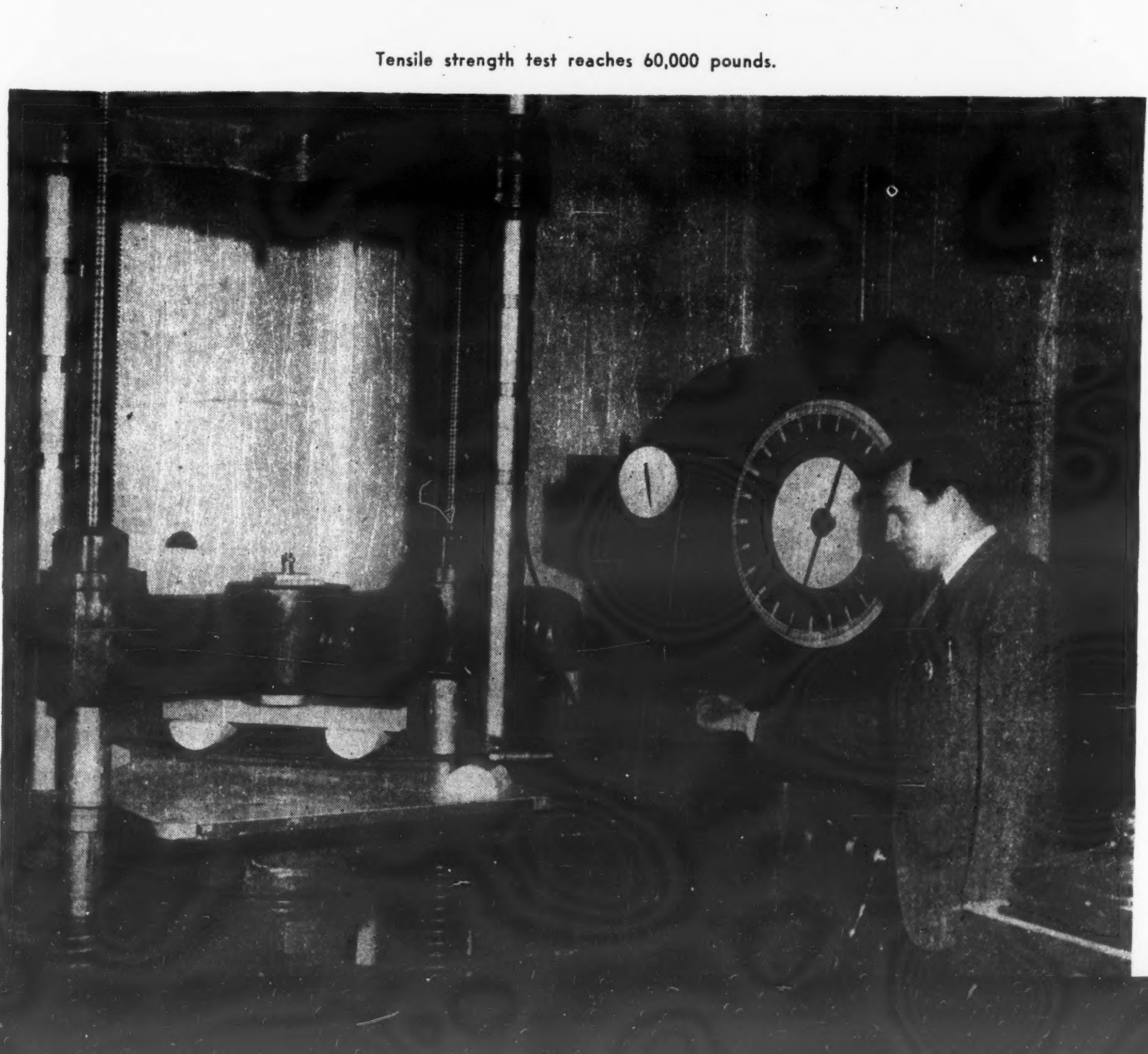
Certainly unless America is to find itself committed to the battlefield with equipment obsoleted by devices of a scientifically conscious enemy, its own research and development programs must continue on an unimpaired scale. If Providence was on the side of the large battalions in the first world war, and favored the large factories in the second, the electronic devices and supersonic missiles of a third conflict would soon bring providential intervention to the side of the large laboratories.

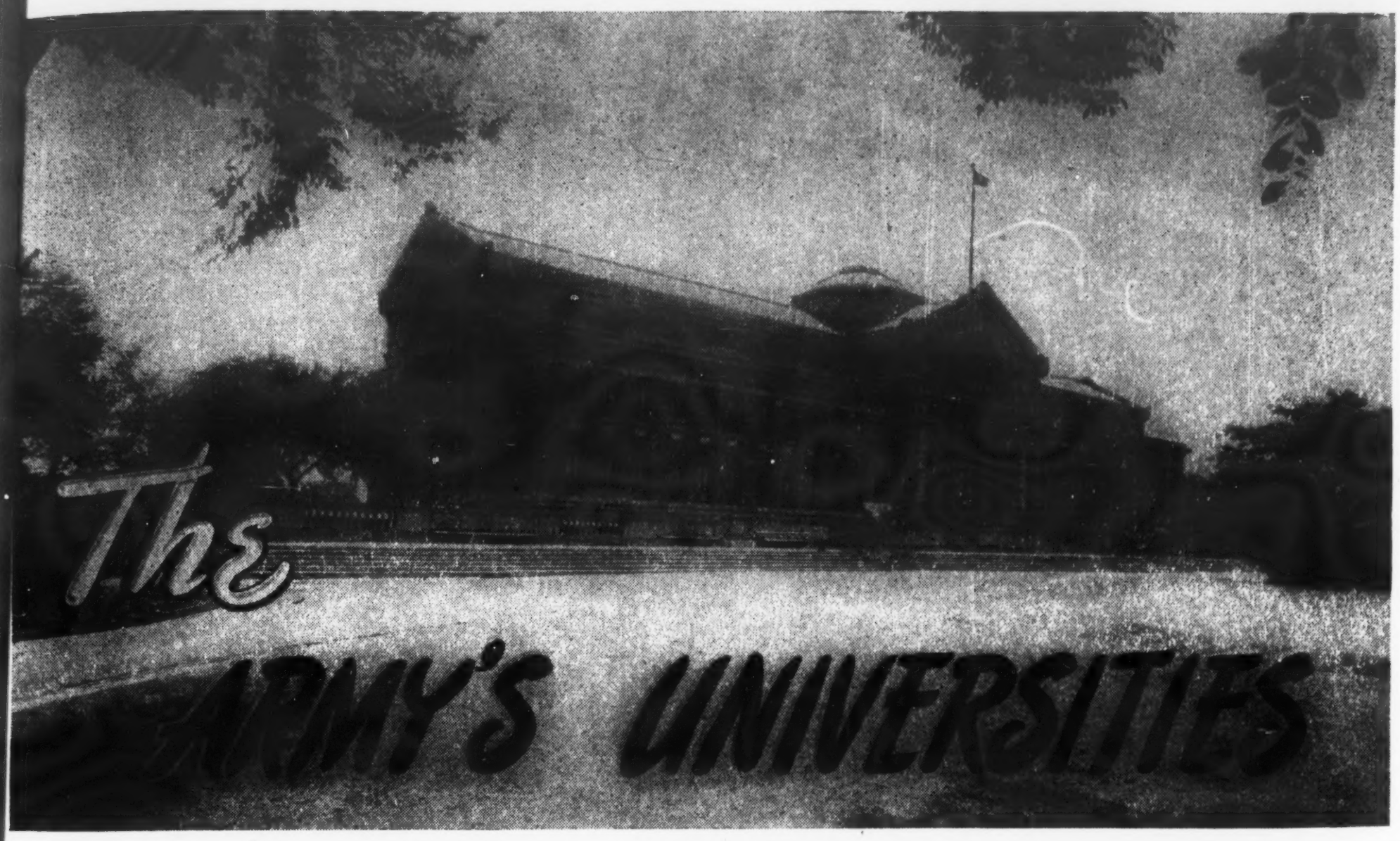
This all-important role of science was recently emphatically underscored by the Secretary of War. "Science and technology," he pointed out, "have changed and are changing the lives of all men. No single aspect of our society fails to feel their advance.

"The things we make, the food we eat, the clothes we wear, the way we travel and communicate, the houses we build, the way we cure and prevent disease, the way we fight . . . have all been fashioned by science.

"Both war and peace move under the sign of research, discovery, and invention."

Tensile strength test reaches 60,000 pounds.





. . . the stamp of Benning, Sill, Leavenworth and Riley lay on every American battlefield

THE THREE-YEAR burgeoning of an army of 140,000 soldiers into an eight-million man striking force, trained and equipped for global warfare, was one of the greatest organizational achievements in history.

America's peacetime Army, starved in men, equipment, budget, lay dormant in a period of dynamic technical development while aggressor nations were feverishly building powerful war machines. From such lean beginnings it was a near miracle that we could salvage the victory in so little time.

Voicing the appreciation of the British people for America's part in the war, Winston Churchill, in a speech delivered at Washington in 1946, expressed his amazement at the speed with which a powerful fighting force was built from a very small nucleus of professional soldiers:

"I greatly admire the manner in which the American Army was formed. I think it was a prodigy of organization, of improvisation. There have been many occasions when a powerful state has wished to raise great armies, and with money and time and discipline and loyalty that can be accomplished. Nevertheless, the rate at which the small American Army of only a few thousand men, not long before the war, created the mighty force of millions of soldiers, is a wonder in military history.

"I saw the creation of this mighty force—this mighty Army, victorious in every theater against the enemy in so short a time and from such a very small parent stock. This is an achievement which the soldiers of every other country will always study with admiration and with envy.

"But that is not the whole story, nor even the greatest part of the story. To create great armies is one thing; to lead them and to handle them is another. It remains to me a mystery as yet unexplained how the very small staffs which the United States kept during the years of peace were able not only to build up the armies and air force units, but also to find the leaders and vast staffs capable of handling enormous masses and of moving them faster and farther than masses have ever been moved in war before.

"That you should have been able to preserve the art not only of creating mighty armies almost at the stroke of a wand—but of leading and guiding those armies upon a scale incomparably greater than anything that was prepared for or even dreamed of, constitutes a gift made by the officer corps of the United States to their nation in time of trouble, which I earnestly hope will never be forgotten here. And it certainly never will be forgotten in the Island from which I come."

Blue-print For Victory

WITHOUT the men and equipment necessary for large-scale field maneuvers—the test tube for battle—our military leaders, during the peace years, had turned to the only alternative: a comprehensive school system. The blue print for victory was prepared in the classrooms of the Army's universities.

Each branch of the Army has

He was amazed . . .

maintained at least one specialist school to which selected officers from that and other branches were detailed for instruction. During the nine-month courses students and instructors were relieved of all other duties and devoted their attention entirely to study, practical problems and exercises. The lieutenant of Air Corps, for example, learned the intricate problems of supply, tactics and logistics of the largest air units. When he had finished the course, the lieutenant knew in detail what a group commander—a colonel—must know. This was true of all the Army branch schools. Considering the scope of these courses, it can be understood why the captain or major of the 1930s could become a general officer in World War II. And General Eisenhower's meaning is clear when he said: "The stamp of Benning, Sill, Riley and Leavenworth is on every American battle in Europe and Africa."

To the highest level staff colleges were sent selected graduates of the several branch schools, after field experience as instructors or with troops. The course of study was two years at the Command and General Staff School, and one year at the others. The students performed all the functions involved in supplying, moving, equipping and assembling field forces—divisions, corps, armies—and engaged them in mock combat in map problems in which every conceivable tactical and logistical situation was reproduced in minute detail.

The Top Schools

AT the top of the Army's school system were the War College and the Industrial College, now the Industrial College of the Armed Forces. The curriculum at the latter institution covered every phase of supply, procurement and production of military materiel on the vast scale required for modern mechanized war. The War College trained high ranking officers in problems bearing directly on the national defense. Procedures in mobilization and personnel management were first evolved there. The policy to officer the lower echelons with graduates of officer candidate schools originated at the War College. This decision resulted in the commissioning of more than 60% of all officers from among men who had originally served in the ranks.

Restrictions in troops and equipment made it impossible to properly test many operational theories and policies until we were actually at war. This lack of practical experience made it impossible to solve the many problems concomitant with the mass handling of men until mobilization was in progress. Then the desperate lack of time greatly aggravated problems that could easily have been solved in peacetime study and application.

The reorganization of combat units into triangular divisions was one of the few major changes that was given a thorough trial in the field. Under command of then Brigadier General McNair, units were assembled at Fort Sam Houston, Texas in 1937. Troops were so few that they had to be transported from points as far distant as New Jersey, 1800 miles away. Much of the later battle success of our ground forces was the direct result of the 1937 Texas maneuver.

Many of the Army schools had short courses for National Guard and Reserve officers. The small core of Regular Army personnel were far too few to staff our enormously expanded combat forces and it was fortunate that our citizen soldiers were able to prepare themselves at these institutions for the responsibilities that came with the war. Major General Miller G. White, of the Georgia National Guard, is typical. He headed-up the War Department General Staff Personnel Division for the greater part of the war. Many others commanded field forces with distinction in all theaters of the war.

Since V-J

WITH the hard lessons learned from peacetime restriction and a wealth of wartime experience, the Army has already reestablished an enlarged system of schools and universities, incorporating the latest techniques in military ideology and technological planning. The new educational system provides for the progressive military education of an officer from his commissioning until he completes a course at a high-level school conducted on a joint Army-Navy-Air basis. The system will provide training during the first twenty years of an officer's active duty, integrated with periods of applicatory field experience.

First, for all officers except those in the Air Force would come a four-month course in subjects common to the Army as a whole, followed immediately by a five-month basic course for branch indoctrination.

After a varying period of field duty the officers become eligible for assignment to the two top level Washington schools—the National War College and the Industrial College. The former, replacing the Army War College,

is the first school designed to promote integration and understanding between the armed services and the State Department. The Commandant, Vice Admiral Harry W. Hill, USN, with his two deputy commandants, Major General Alfred M. Gruenther and Brigadier General Truman H. Landon, opened the school in September 1946.

The course is divided into two semesters, the first of which covers the effect of science and technology on war; international politices; basic conflicts in international relations; and measures of peaceful pressure and adjustment. Concurrently, studies in the war potential of selected nations will receive critical examination. Through these courses the classes should arrive at an understanding of United States foreign and domestic policy and its objectives.

The students, all brigadier generals, colonels or Navy captains, were divided into committees for their first sub-course, "Security in the Atomic Age," a review of all aspects of international control of atomic energy. Outstanding authorities who will address the class include James B. Conant, President of Harvard University; Senator Brian McMahon of Connecticut; John M. Hancock of the Baruch Atomic Energy Commission; Charles A. Thomas, member of the Lilienthal Board; J. Robert Oppenheimer, former director of the Los Alamos Laboratory of the Manhattan Project; Bernard Brodie of Yale; Vice Admiral W. H. P. Blandy; and Major General Leslie R. Groves.

The second semester will include studies involving the implementation of national policies. Military power as a means to an end will be the theme with planning on the level of the Joint Chiefs of Staff receiving special attention.

An important part of the curriculum which has resulted from the recent war is a course of science appreciation. It is designed to produce an understanding between scientists and military planners in the hope that technological developments will be utilized to the maximum.

The Industrial College

THE Industrial College of the Armed Forces will emphasize the theory and practice of industrial mobilization during a ten-month period. On 1 February 1947 Lt. General Delos C. Emmons, the Commandant of the Armed Forces Staff College at Norfolk, Virginia opened the first of two five-month semesters for the year. The student body of 150 officers was equally divided between the three services. The school, designed to train selected officers in joint operations, will provide orientation in organization; characteristics, employment, and inter-relation of the services; joint staff techniques and procedures; preparation of joint amphibious and airborne operational plans; the organization, composition and function of war theaters and major joint task forces and the responsibilities of commanders of such organizations; and the study of trends in new weapons and scientific developments.

Qualifications for entrance to the Industrial College require that the student be a Regular Army officer, or non-regular in Category 1 with a minimum of eight years' commissioned service. He must have a general efficiency rating of superior and be a graduate of the Command and General Staff School or have equivalent qualifications from wartime experience. Officers must be physically qualified for general service and must have demonstrated by performance an aptitude for high command or staff positions.

Seminar in session at Industrial College.

AAF

THE Air Force is operating a separate educational system to train personnel in the complex specialties peculiar to that branch. Chief among these schools is the Air University, supplemented by the Air Tactical School, Air Command and Staff School, Special Staff School, Air Institute of Technology, School of Aviation Medicine and the Air War College.

More than 300 highly qualified officers are pursuing post graduate work in specialized fields at civilian institutions. These personnel are being prepared for duties on a plane even beyond the scope of the comprehensive Army schooling system.

The Services recognize the vital need for a continuing educational program that will insure a corps of commissioned officers with the highest order of tactical and technical training. America cannot again afford to endanger its military security and the Army's universities are one of the most powerful weapons in the national defense.

VHF and MICROWAVE Military Communication Systems

By John J. Kelleher

Engineering and Technical Service, Office of the Chief Signal Officer

Compact high-frequency and FM equipment revolutionized military radio techniques

THE SUCCESSFUL employment of a military force depends largely upon the ability of the commander to communicate his orders to the units under his control and to receive from them accurate and prompt reports. Radio has found an increasingly important place in these communications, due to its ability to match the mobility of modern warfare, and no factor has contributed more to the dependability and versatility of military radio than the development of equipment operating in the VHF and microwave portions of the spectrum.

VHF radio equipment is of three general types, dependent upon operational employment: first, short-range units for combat troops; second, sets for air-to-air and air-to-ground communications; and finally, VHF and microwave multi-channel radio relay equipment for fixed ground and point-to-point operations. "VHF" is understood to define the frequency band between 30 and 300 megacycles: "microwave" relates to frequencies in the UHF or SHF bands, between 300 and 30,000 megacycles.

Combat Equipment

Prior to 1940 practically all military radio communications were conducted below 30 mc. because techniques and circuitry were well defined at those frequencies and the current tactical doctrine placed primary dependance upon wire for communications. Radio was considered a stand-by facility to be used in event of failure of wire circuits or when the tactical situation prohibited the installation of wire. The number of radio nets on the air at any one time was small and there was sufficient space in the HF spectrum for all services.

The concept of warfare was rapidly changing, however, and increasing mobility of military forces necessitated the widespread use of radio as a primary means of communications, particularly in the forward combat areas. The situation was met at first by providing additional equipment operating in the medium and high frequency bands with generally unsatisfactory results. The dependable communicating range, already curtailed by relative inefficiency of vehicular and aircraft antenna systems at those frequencies, decreased as a result of interference, whereas the distances over which communications were required steadily increased. Power output was raised to the limit of vehicular installations in an attempt to solve the range problem but results were disappointing because the added power served mainly to increase the interference. Moreover, communications were interrupted at times by ionospheric, atmospheric, and man-made disturbance and on longer circuits, by propagation vagaries, such as skip-distance. Transmissions which could not be heard by the intended receiver some 25 or 30 miles distant reappeared hundreds of miles away, causing serious interference with communications in those areas.

Another factor limiting the effective employment of high frequency equipments was the human element. The sets had a multitude of controls and communication often depended upon the skill of the operator in adjusting for maximum power output on the proper frequency.

SCR-508 installed in half track M-2.

Practically all operators had to be reasonably proficient in handling code, as there were many occasions when conditions prevented successful voice contact.

Typical of the vehicular high frequency equipment of the pre-VHF period was the SCR-245. The transmitter, operating between 2000 and 4500 kc., was crystal or master-oscillator controlled, and had a power output of about 25 watts on voice and CW into a 15-foot whip antenna. The range was 15 miles on voice, 25 miles on CW. The equipment weighed about 200 pounds installed and the primary power requirements were approximately 23 amperes at 12 volts. The operator had to manipulate no less than seven separate tuning controls to secure maximum performance.

The Signal Corps development laboratories had been investigating the possibilities of VHF for military communications for several years, knowing that those frequencies were relatively noise-free, that the absence of sky-wave propagation would practically eliminate long-distance interference, and that the efficiency of short antennas at those frequencies would permit a considerable reduction in weight, bulk and power.

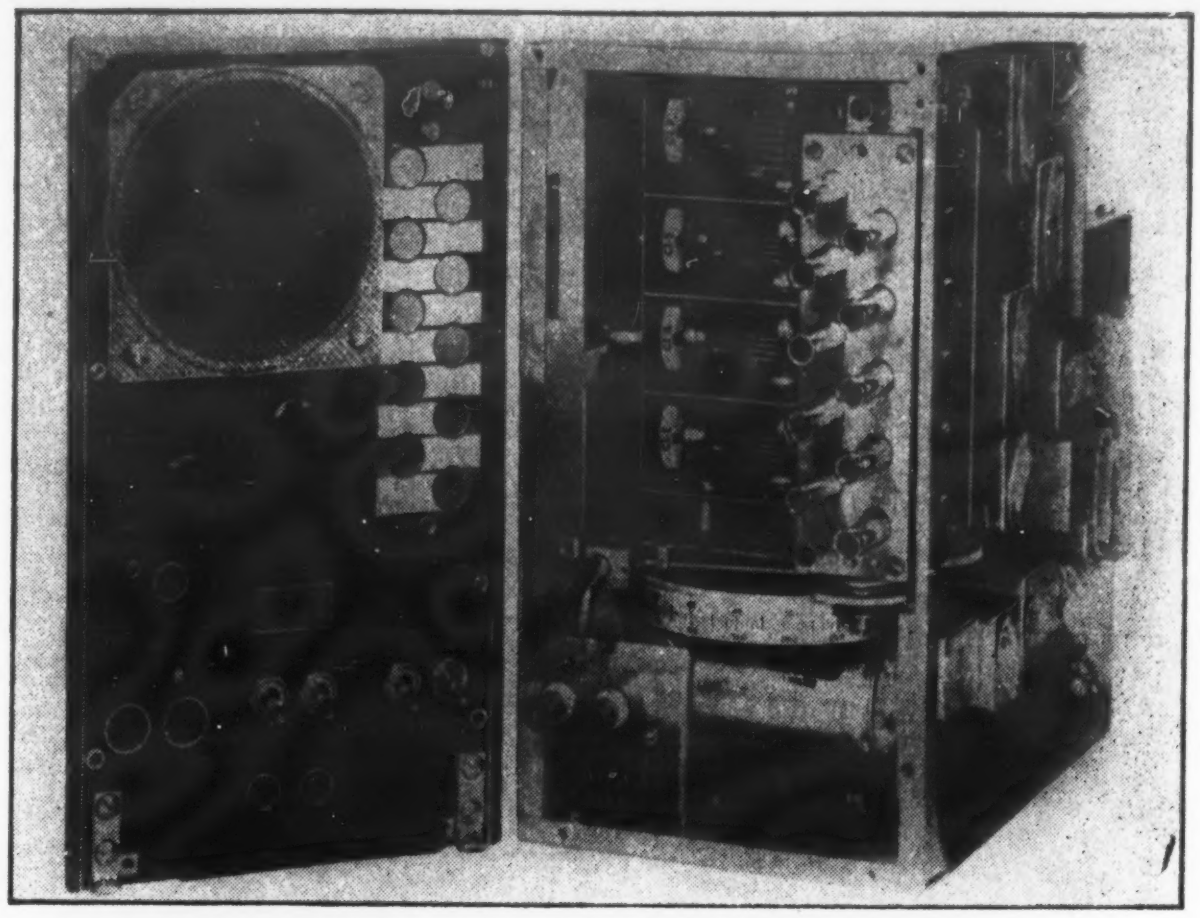
The first hesitant step in the migration to VHF was taken in 1937 when Radio Sets SCR-194 and -195 were adopted for short-range operation within the artillery battalion and the infantry regiment. These units were representative of the period—simple two-tube, dry-battery powered, super-regenerative transceivers operating in the bands 27.7 to 52.8 mc., and 52.8 to 65.8 mc., respectively, and capable of voice communication over distances up to five miles. They were designed primarily for portable operation and, weighing only 25 pounds complete, could be carried quite easily on a man's back. These sets partially relieved the congestion in the HF band and they did not require trained CW operators but they had certain disadvantages. Notably, the super-regenerative detector radiated so strongly that it blocked reception of other sets on the same frequency within a radius of a half-mile. The SCR-194 and -195 were replaced in 1942 with vastly superior frequency modulated equipment.

Interference in the HF band continued to increase and the problem reached a climax late in 1939 when the newly-activated Armored Force, having proved in maneuvers the inadequacy of the available equipment, specified the characteristics it required in radio communications equipment. Vehicular radio sets of radically new design were requested, capable of operating on any one of ten different pre-set frequency channels, each of which could be selected by the operator by merely pushing a button! The Laboratories decided that this and other requirements could only be met with VHF equipment using crystal control and a contract for development models was placed early in 1940.

Meanwhile municipal, county and state police departments, which were relying increasingly on radio for vehicular contact, could no longer tolerate the interference experienced on lower frequencies. They turned to high frequency as the only solution and by 1939 several manufacturers were producing amplitude-modulated mobile police equipment, functioning above 30 mc., designed for operation on a single, crystal controlled frequency channel. Since this development obviously offered possibilities for military application, the Signal Corps laboratories lost no time in securing test models of the sets.

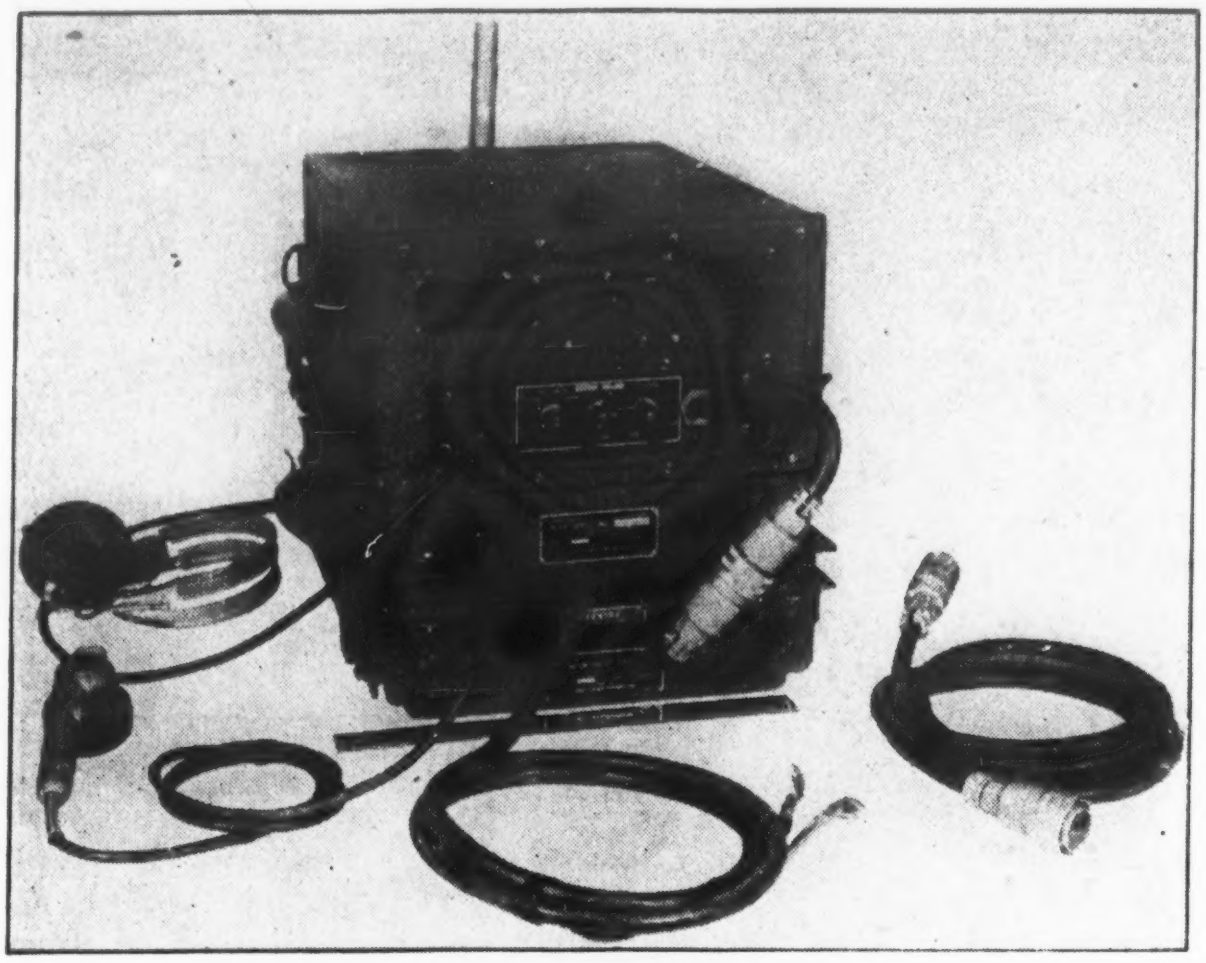
In 1936 Major Edwin H. Armstrong, designer of the superheterodyne receiver circuit, announced a new development which changed the entire aspect of military communications and insured the success of VHF. His system of frequency modulation, first considered primarily useful for noise-free high-fidelity broadcasting, was also found to be the solution for the worst problem of vehicular communication: ignition interference. Protective shielding had already about reached its ultimate development for vehicular radio equipment but had proved inadequate. Frequency modulation seemed to offer the solution.

The switch to FM was by no means immediate, however. Experimental models of vehicular sets were constructed at the Laboratory as early as 1939 but contracts placed early in 1940 for



Front view of SCR-508 receiver.

John J. Kelleher's experience with the Signal Corps began in 1932 when he enlisted at Fort Monmouth. He served until 1937 as an operator and technician at station WVB, Ft. Sam Houston, Texas and as an instructor in the Radio Division of the Signal Corps School. After three years with RCA Communications in New York, he became associated with SCEL in 1940. For the past five years he has specialized in VHF and microwave systems engineering, and was a member of the Signal laboratory group which designed and installed the first military radio relay system in North Africa in 1943. Since July 1943 he has been associated with research and development of ground radio equipment in the Office of the Chief Signal Officer.



SCR-610 is an Artillery unit.

development models of a set for the Armored Force still specified amplitude modulation. Experiments continued, however, and early in 1940 were accelerated by commercial production of FM police radio units.

Throughout the summer and autumn of 1940 comparative tests of FM and AM were conducted by the laboratories, police departments and the manufacturers. Conclusive evidence accumulated rapidly. In almost every case, noise which seriously interfered with AM circuits was hardly audible on FM. When FM was used, ignition interference at VHF could be suppressed by means so simple and straightforward that they could be applied to every military vehicle during construction.

Consequently, before the first development model of the push-button tank set was delivered, the contract was modified to specify frequency modulation and the Laboratory commenced development of other frequency-modulated vehicular and portable equipment which, used in conjunction with the tank sets, would provide a completely integrated radio communications system within the Armored Force Out of this program emerged the "500" series: SCR-508, -509, -510, -528, and -538, all FM and operating in the range 20 to 27.9 mc.

These five sets are divided into two groups: the SCR-508, -528 and -538, which are comparatively large and heavy vehicular units with a dependable range of from 7 to 10 miles; and the SCR-509 and -510, smaller, portable and vehicular sets, reliable over distances of from 3 to 5 miles. The 508, 528 and 538 all employ the same basic components, and the 509 and 510 likewise use the single transmitter and receiver, varying only in that different power supplies are furnished for portable and vehicular operation.

The SCR-508 and -528 transmitter is a crystal controlled, phase-modulated unit with an output of 30 watts on any of 80 channels in its frequency range, spaced 100 kc. apart. Crystals for any ten of these 80 channels are carried in a temperature controlled oven, ready for instant operation. The maximum frequency deviation at 100% modulation is about 80 kilocycles. As is common with all phase-modulated transmitters, a rather high order of frequency multiplication, 54 times, occurs between the crystal oscillator and the final amplifier.

The principal element of the tuning system is the push-button assembly, which performs an amazing variety of chores. Depressing any one of the ten connects the proper crystal into the oscillator circuit, drives a six-gang tuning condenser to the proper setting, tunes the power amplifier condenser and connects into the circuit the proper one of ten antenna loading capacitors, each of which has been preset during the tuning process.

The receiver is a conventional single superheterodyne with an IF of 2.65 mc. The push-button assembly has the relatively simple task of tuning a four-gang condenser, although the receiver is not crystal controlled and the mechanism has a reset accuracy of about 10 kc. at 28 megacycles. A notable feature of the receiver is the visual call signal which operates in conjunction with the squelch circuit to warn the operator that a carrier is being received.

These sets operate from either a 12 or 24 volt power source, the change being accomplished merely by plugging the appropriate dynamotors into the equipment. Each dynamotor is equipped with a multi-contact plug which makes all necessary changes.

SCR-509 and -510 are considerably smaller and more portable than the 508. The main component is an FM receiver and transmitter which can be completely pre-tuned to two different frequencies, either of which can be selected by a switch on the front panel. The transmitter is straightforward — an electron-coupled oscillator, frequency modulated by a resonance tube modulator, followed by a doubler and a power amplifier with about ½-watt output.

The receiver is a single conversion superheterodyne with crystal oscillator and an IF of 2.88 megacycles. A varying bias is furnished which is applied to the reactance modulator of the transmitter to correct any drift in the mean frequency. Stability is effectively that of the receiver crystal oscillator and both transmitter and receiver must operate on the same frequency.

Production of the 500-series commenced in the latter months of 1942 and figures for the succeeding years give some idea of their use during the war. From January 1943 until August 1945 more than 140,000 units were produced for use in the various assemblies of the series.

As the result of field demonstrations, the Field Artillery Board asked for similar sets operating in the vicinity of 40 megacycles. The result was the "600" series—SCR-608, -609, -610 and -628. In less than three years more than 100,000 of this group were manufactured.

Last of the FM sets designed for VHF tactical operation was

Major components of SCR-300: the famous "walkie talkie."

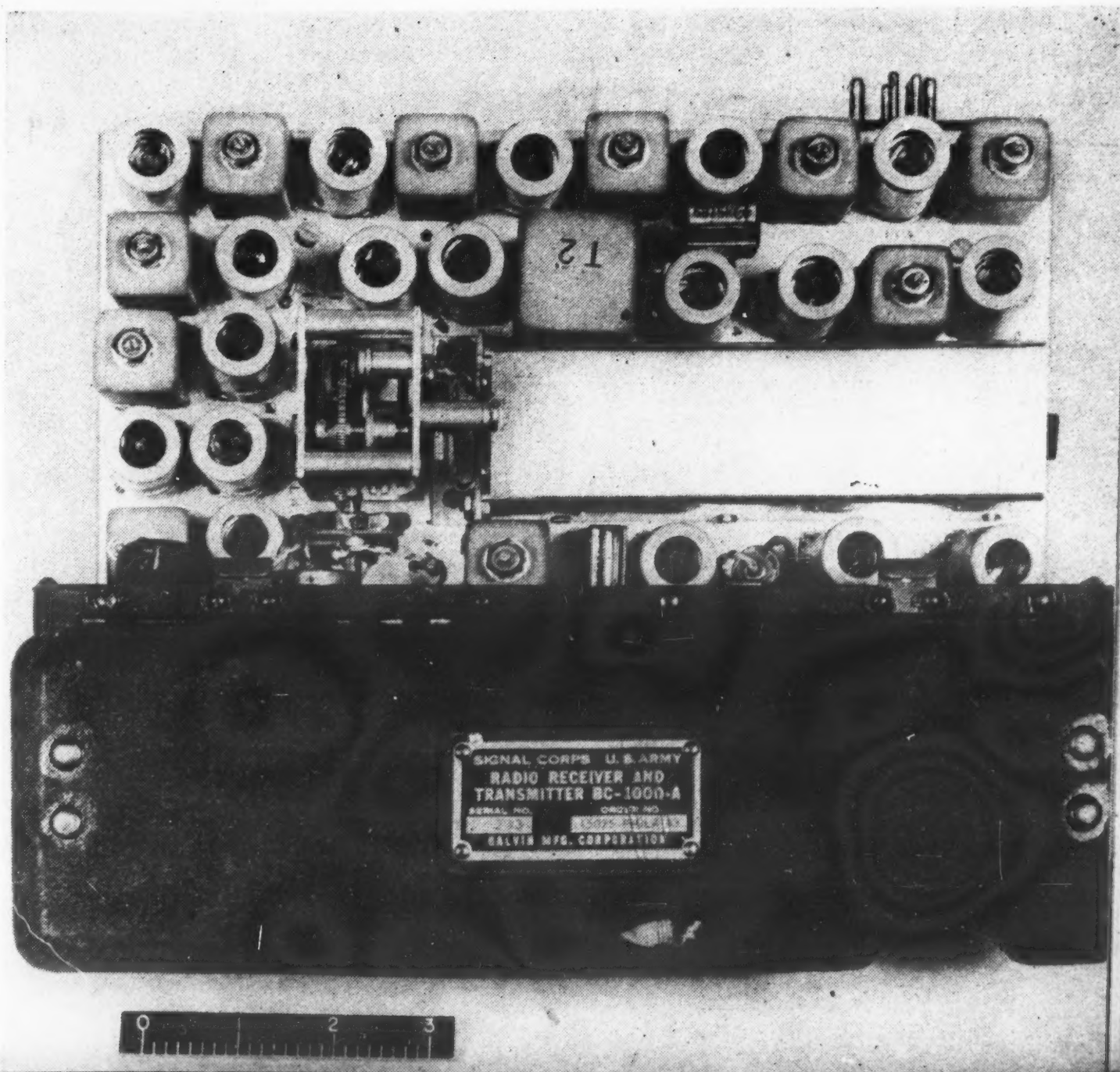
Radio Set SCR-300, the "walkie-talkie." This set has been termed, "the Infantryman's dream for better communication and control of troops by radio," and "the best radio that the Signal Corps has made for the Infantry." It was developed in 1942 to improve communications between the headquarters of infantry companies and battalions.

Weighing only 13 pounds net, the 300 performs very nearly as well as its 27-pound relatives, the SCR-509 and -510, and provides solid communications over distances of three or more miles. The transmitter and receiver resemble those of the 509 in that stability is achieved through so-called "monitor" crystals and AFC circuits rather than by direct crystal control of the transmitter oscillator.

The transmitter oscillator is continuously tuneable over the frequency range 17.85 to 21.85 mc., and is followed by a doubler, the output of which is 35.7 to 43.7 megacycles. The doubler frequency is then mixed with that of a 4.3 mc. crystal oscillator and the sum, lying between 40 and 48 mc., drives a power amplifier having an output of approximately 3/10 of a watt. The transmitter output, suitably attenuated, also serves as the receiver high frequency oscillator, beating with the incoming signal to give a first IF of 4.3 megacycles. This is amplified, mixed with the output of a 6815 kc. crystal oscillator to give a second IF of 2515 kc., which is amplified, limited and detected in the normal manner. The output of the discriminator also provides an AFC bias voltage which is fed back to the reactance modulator and corrects the average frequency of the common oscillator for best reception of the incoming signal.

Airborne Equipment

By 1943 the great majority of short-range ground radio had been transferred to the VHF spectrum, where the Army Air Force was in active operation. The VHF program of the AAF



Top-view of receiver-transmitter portion of SCR-300.

dates back to 1939 and earlier, when the then Signal Corps Aircraft Radio Laboratory at Wright Field, Ohio, which was responsible for the development of airborne radio equipment, decided to abandon the HF band. Because of the tentative plans to move ground tactical communications into the region 20-50 mc., the sparsely occupied bands just above 100 mc. were chosen for experimentation. In 1939 a contract was placed for development models of airborne equipment designed to operate between 100 and 130 mc., and with the frequency stability of crystal control without using that method.

The set had to be capable of operation on any one of four RF channels, instantly available by push-buttons, and had to provide plane-to-plane and plane-to-ground communications up to 150 miles under approximately line-of-sight conditions. Models of this set, SCR-264, were not delivered until 1943 and since it had become obsolete, it was never adopted for military use. This same line-of-sight phenomenon had kept tactical equipment below 50 mcs., where transmission is not strictly limited to the visible horizon.

Concurrent developments in the international situation resulted in a 1941 decision that British and U. S. fighter and fighter-control communications should employ common freqeuncies and, insofar as possible, similar design, to permit the direct interchange of crystals between British and American equipments. The British had a VHF aircraft set which operated between 100 and 126 mc., and models were brought to the U. S. for study. The design proved acceptable and, as time was so short, various manufacturers were asked to build a few thousand reasonable facsimiles.

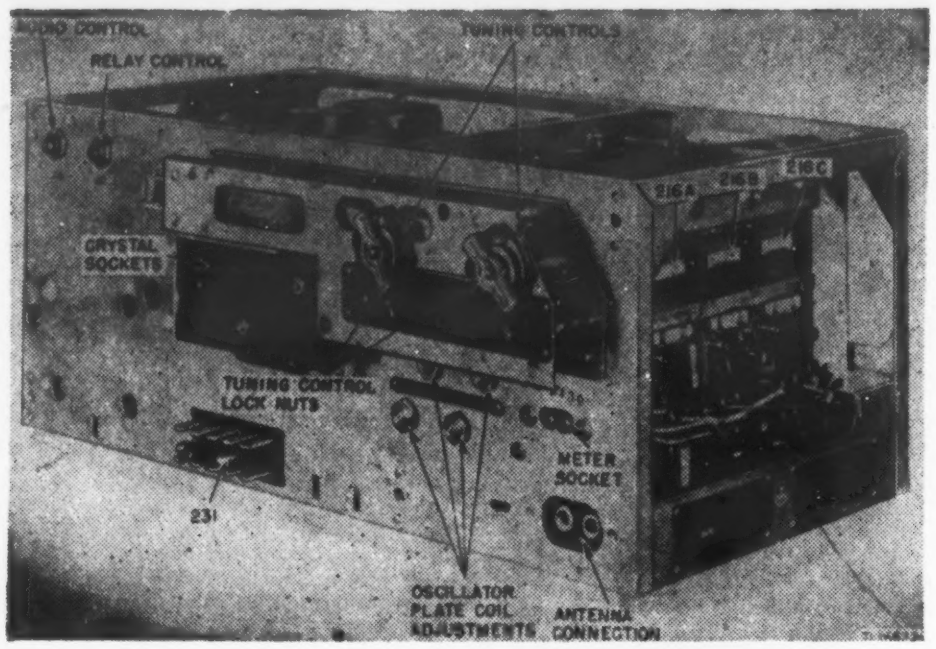
Soon, Radio Set SCR-522 began to roll off the production lines. It has an output of about 8 watts, is amplitude modulated and is operable on any one of four channels in the range 100-156 megacycles. Both transmitter and receiver are crystal controlled and are quite conventional with the exception of the remotely controlled channel selector mechanism.

The selecting method used in the SCR-508 has as its primary function the positioning of a single multi-section condenser so that the stages must track quite accurately over the band if maximum efficiency is to be obtained. No such limitation is imposed by the tuning mechanism in the SCR-522. Each of six different tuning controls may be individually adjusted for optimum performanace on each of the four channels and then returned to any one of the four settings by simply pressing buttons on the remote control box.

The antenna systems used with this and later airborne equipments were unique. In the SCR-522 it was a quarter-wave stub approximately 22 inches in length, specially designed for broad-band operation. An indication of its excellent performance is that a power output of 8 to 10 watts was obtained over the entire band 100-156 mc. without tuning the antenna circuit and with a standing-wave ratio on the transmission line of no more than 1.7 to 1.

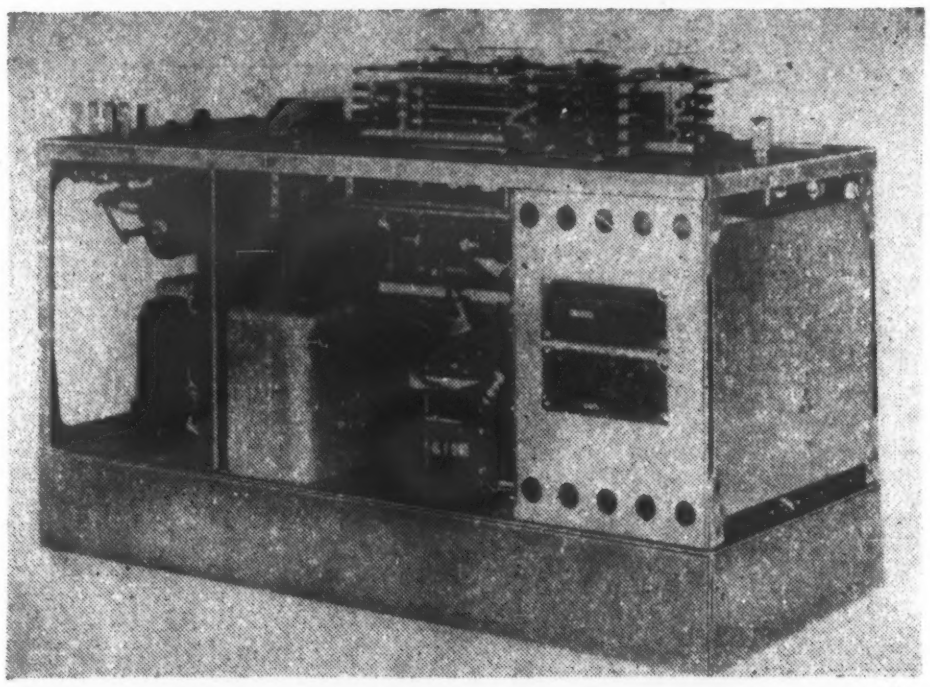
In some installations a clock-type contactor mechanism was included which provided automatic, periodic transmission of a 1000-cycle tone on one of four channels to facilitate location and direction of the aircraft by ground based direction-finding stations. This circuit operated independently of the position of the controls on the pilot's remote control panel.

Development of both air and ground radio communications has not ceased with the end of hostilities. Enormous progress is being made throughout the radio spectrum and equipment is approaching the optimum in performance, maintenance and efficiency.



SCR-522's receiver component.

Transmitter for airborne SCR-522.



(In the next issue of SIGNALS *Mr. Kelleher will describe the spectacular development and use of VHF radio-relay links as integrating networks in wire systems.)*

Air-Sea Rescue VHF-DF station; Saffron-Walden, Essex, England.

Radio for "Overlord"

By Brig. Gen. Francis H. Lanahan, Jr.

Chief Signal Officer, European Theater

In which we conclude the review of top-level signal planning for the Invasion of Europe

TWO OF THE most important and difficult tasks which faced the planners of signal communications for the invasion of Europe in 1944 were frequency allocation and the clearance of interference. As it was aptly put: "We were attempting to assemble the greatest ether orchestra in history and the planning would determine whether the orchestra produced music and messages or chaos and confusion."

The major factors in radio allocation were: the unprecedented number of transmitters to be concentrated in an area of approximately 90,000 square miles; the large number of military units operating in the 2 to 8 megacycle band; the newly developed and somewhat unknown radar devices; the large number of radio devices used by the strategic bombing and fighter defense forces; the employment of powerful but newly developed radio jamming equipments for the protection of night bombers, the anticipated mutual interference between nearby radio and radar installations, and the anticipated operation of a considerable system of navigational aids.

Since, during the early months of the projected operation, nearly all of the high frequency transmitters would be less than 200 miles apart, it was apparent that all services would want most of their frequencies in the band between 2 to 5 megacycles and that the demands would exceed the available number of channels. It was also apparent that the operation of radar equipment in Southern England, the Channel area, and the beachhead would cause mutual interference between the several radar equipments and between radio and radar equipments unless the use of radar aids was coordinated among the various commands of the expeditionary forces and also between these elements and the strategic defense forces in the United Kingdom. Since many of the radar devices were of recent development and their interference potentialities not fully known, much study and testing was required of the planning group.

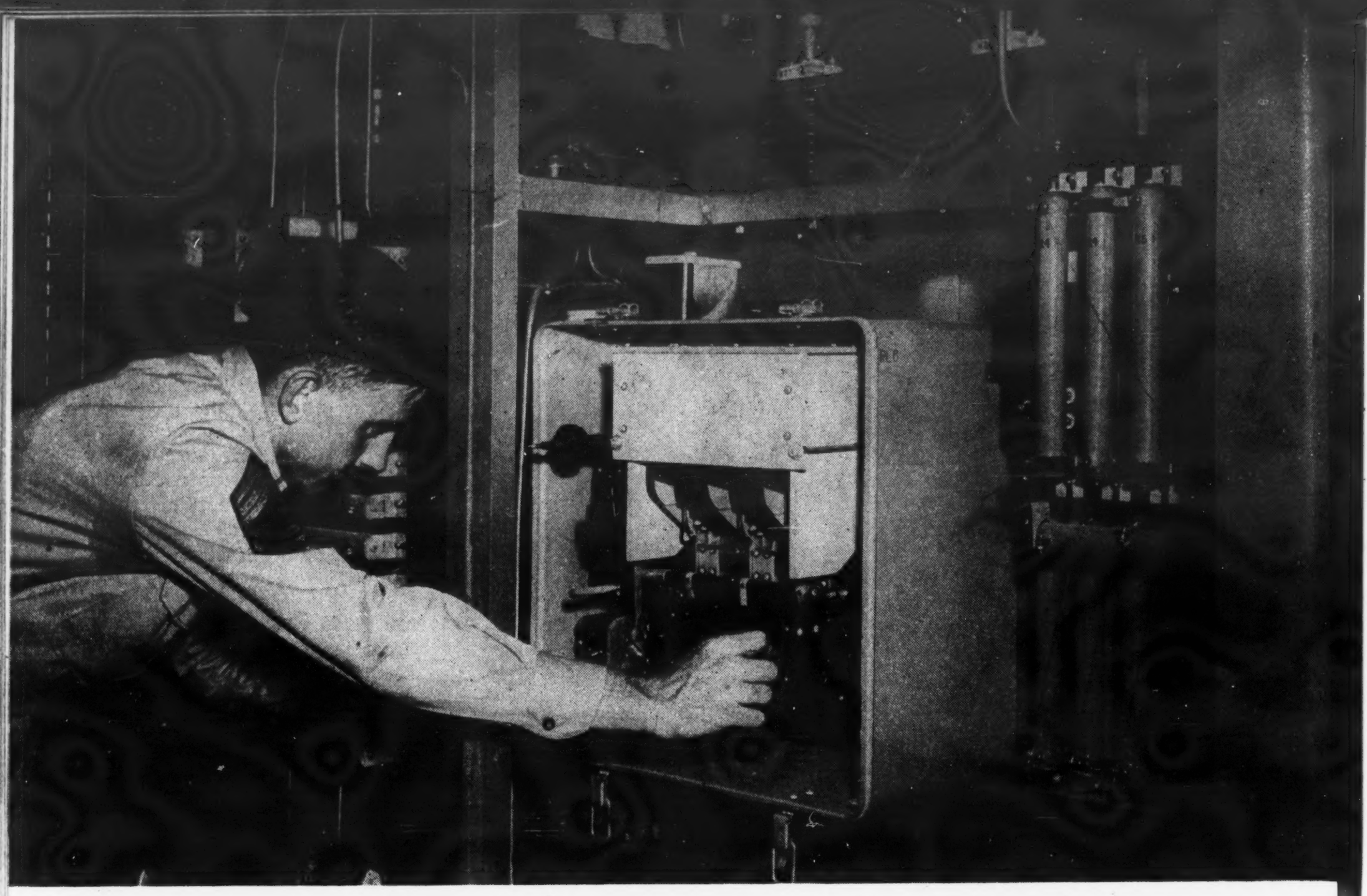
Since a number of powerful counter-measure devices were employed to neutralize enemy radar and fighter control radio equipments, the effect of these devices on friendly radar and radio plans also required serious study.

Interference Problems

It was realized that regardless of the correctness of planning, there would inevitably be interference in the United Kingdom, on the beachhead and between these two areas, and that a signal organization for the rapid clearance of such interference would be essential.

In the field of radio frequency allocation, it was estimated that during the assault phase there would be approximately 30,000 HF radio transmitters, 10,000 VHF radio transmitters, 3,000 radar devices, 400 navigational aid equipments, 100 radar and radio counter-measure equipments, and about 9,000 identification devices.

The basic cross-channel and near-shore lateral communications were for the most part based upon the "South Coast Scheme," a very elaborate VHF (radio link) system originally evolved by the British in anticipation of an invasion across the channel. The VHF equipment was installed on the near shore with necessary connecting lateral wire extensions. A reasonably accurate survey of sites on the far shore had been made after careful studies of radio paths, defensibility and the scheme of maneuver. It was necessary only



OVERLORD equipment included such units as this 15-kw. transmitter.

to select and coordinate these far shore sites and to plan the lateral connections between them. Then steps were initiated to coordinate the whole frequency system and to avoid interference with the radar; radio aids to navigation; and the naval, air and ground communications.

Radio Frequency Committee

The agency which was activated to plan and allocate radio frequencies for the invasion was the Radio Frequency Committee of the Combined Signals Board of Supreme Headquarters. On this committee were representatives of the Combined Air Forces: the British 21 Army Group; the American 1st (later 12th) Army Group; the 8th Bomber Air Force, U. S.; the Bomber Command, British; the 9th Tactical Air Force, U. S.; the 2nd Tactical Air Force, British; the Combined Naval Command, and representatives from Supreme Headquarters who, in addition to their other duties, represented the interests of numerous supporting agencies such as the press, Psychological Warfare, OWI, OSS and numerous others.

After obtaining from the British Wire Telegraph Board the existing allocations of frequencies within the United Kingdom and determining what frequencies must be retained for strategic bombing, Empire communications, BBC broadcasts to Europe, etc., the Board proceeded to determine frequency requirements in the HF spectrum by requesting bids and requiring full justification for each channel indicated as required. When the bids were received, study showed that the spectrum between 2 and 8 megacycles had been over-bid 400% and that between 2 and 5 megacycles had been over-bid 700%. It was obvious that maximum economy by all commands was imperative, that sharing of frequencies within and between commands must be tolerated, and that only the minimum necessary power could be employed by each transmitter.

The following rules were agreed to cover the allocation of frequencies:

a. All services accepted the same degree of frequency sharing compatible with power of equipment.

b. The number of frequencies allotted to each service was based on the bids as amended during discussions.

c. An upper limit of power was imposed on each frequency

d. The entire area of operations was to be divided into zones approximately 40 miles square and each frequency was authorized for employment in designated zones only.

e. Within the expeditionary forces, only assault frequencies were given special protection (by insuring that comparatively low power was used on adjacent channels employed by other services).

f. As far as practicable, blocks of consecutive frequencies were allotted to individual services to facilitate a clearing of interference without a great deal of inter-service communication.

g. The exact duplication of frequencies employed by adjacent fixed high-powered transmitters was to be avoided.

h. The separation of adjacent frequencies was set at 5 kilocycles.

i. Inter-service sharing of frequencies was to be held to a minimum.

j. Crystal control would be employed whenever practicable.

When master oscillator control was used, sets would be checked frequently by crystal frequency meters.

k. The maximum use would be made of other means of communications to economize on radio frequencies.

After several weeks of discussion, during which it developed that every sixth ground division and every third armored division would have to share frequencies, it was determined that there must be an inter-service sharing between air and ground forces of 20% of the frequencies. A tentative allocation of this portion of the spectrum was established and agreed to by all participants in December 1943. Immediate work was started on the grinding of the tens of thousands of crystals which would be required.

In February, the Commander-in-Chief of the Allied Air Forces informed the Supreme Commander that the frequencies allotted to the 9th Tactical Air Force were insufficient for the needs of that unit. Further inter-service discussion resulted in an agreement that the air force needs could be met only by reducing the frequency separation to 4 kilocycles between 1.5 and 4 megacycles and by transferring approximately 30 frequencies from the ground forces to the air forces. On the basis of this agreement, a plan was eventually evolved under which the 1600 high-frequency channels available between 1.5 and 8 megacycles were broken down into shared and unshared assignments and allocated to the major units by block or by individual assignments. In turn the major subordinate units were required to arrange a certain amount of sharing between and within subordinate commands. Further, each frequency assignment carried with it a power limitation, varying from 25 watt maximum to 500 watt maximum, with only a few specific-use frequencies allotted higher power. The revised allocation was issued on 10 May and the necessary re-grinding and distribution of crystals proceeded at top speed.

VHF

The task of allotting the high-frequencies being well started in the Fall of 1943, the really difficult problem of the VHF and UHF requirements was tackled. Involved were the cross-channel VHF telephone and telegraph networks, the navigational aid systems, identification equipment, all of the fighter air communications, most of the bomber networks plus all naval, air forces, and artillery radar.

The VHF portion of the spectrum usually appears limitless as to channel capacity. However, because British and American equipment had to be operated together, allowance had to be made for enemy uses and because in the development of the equipment of any one nation full account had not been taken of interference possibilities, the problem was unusually complex.

A special group of American and British electronics engineers representing the U. S. and the British Armies, the Allied Air Forces, and the Royal and the American Navies, was formed to coordinate the frequency assignment and siting for all electronic devices operating within the VHF and UHF ranges.

It was found that the problem of mutual interference was more extensive than at first realized. Due to the recent development of much of the equipment, full information on interference capability was not readily available. Hence, it was necessary to conduct a number of tests in Northern England and Scotland with radio and radar devices to determine the interference susceptibility of various equipments, determine the methods for minimizing this interference by proper siting with respect to other equipments, by careful planning of frequency allotments, by the establishment of restrictions on power, and by specifying types of antennas to be employed in congested areas or when in proximity to certain other equipments. After the conduct of the tests and the drafting of necessary employment instructions, the frequency allocation in the VHF and HF ranges was completed and issued.

With the increased employment of electronic devices, the necessity for an adjudicating staff or committee became increasingly important. Throughout the operation, conflicts developed due to mutual interference. These differences were readily solved

Radio-relay provided a vital link in fluid communications.

when competent engineers were available to study the problems. Many difficulties were resolved by changes in site, shifts in frequency, or by emergency measures relative to changes in power and antenna.

Advisory Party

While every effort was made to avoid interference, it was realized that numerous cases of difficulty would arise on the ground during the progress of the operation. To resolve these difficulties as quickly as possible, there was established a group known as the Mutual Interference Advisory Party. This unit was constituted in three elements: a main party which was established at the main headquarters of the ground forces at Portsmouth, and two operational parties on the beachhead, one for the U. S. Sector and one for the British Sector. The main group had access to the monitoring facilities and the communication network of the United Kingdom. Each of the two far-shore detachments consisted of two officers and two enlisted men equipped with very complete mobile monitoring stations especially designed for the task. These groups accompanied the second assault waves ashore on D-Day. Each of the far-shore parties was accredited to an army commander, and was responsible technically directly to the officer in charge of the main party at Portsmouth.

The function of the far-shore parties and of the Main Interference Advisory Party was to monitor continuously the frequencies used by the attacking forces, both HF and VHF and to settle disputes, either by directing frequency, power, or siting changes, or by silencing the less important of the two interfering devices. By agreement, interference was treated as an operational matter handled by command action.

In addition, a Radio Countermeasure Advisory Staff was established to advise Navy and Air commanders on action taken to avoid interference which might arise in the employment of electronic counter-measures. The employment of such electronic counter-measures was studied from the standpoint of a need to meet operational plans. This group was continually studying the interference possibilities arising from the use of available counter-measures equipment and advising the commanders of the anticipated interference and possible operational implications when counter-measures devices, particularly jammers, were to be employed. It was then a command decision to determine whether the gain in the employment of the electronic countermeasure outweighed the loss in reliable communications.

Operations

Certain outstanding accomplishments by the field signal personnel in the operation fully repaid the planners for their weeks of study and work. For example, communication was established with headquarters ships within two minutes of lifting of radio silence and relay communication with the shore parties was established in some cases while they were still afloat in their landing craft. The first multichannel VHF link was in operation across the channel within two hours of the landing of the troops and, with the exception of two or three short interruptions, was continuously on the air from that time. By the afternoon of D plue one, a VHF station had been linked to the telephone system in France and the build-up of the VHF cross-channel network continued as fast as the pre-chosen sites were cleared.

The far-shore interference advisory parties were able to reduce every case of serious interference to major operation within two hours after the receipt of report, or after the observation of interference by monitoring. Approximately one-half of the interference cases were based on reports of interference, and the remainder on monitoring.

During the month of June, 85 complaints of interference on HF operations circuits were referred to Signal Division, SHAEF, for clearing by the radio monitoring terminal. All but three cases, in which the interfering stations could not be identified, were corrected satisfactorily. No case of deliberate interference by the enemy was reported. Shortly after D-Day, a U. S. commercial concern began transmitting from the beachhead to New York on frequencies which had not been authorized. The difficulty was solved by finding frequencies satisfactory for the operation of this outlaw station and by directing the station to change to these clear frequencies immediately.

These VHF receivers were part of Air-Sea Rescue installations.

SCIENTIFIC DEVELOPMENTS

Electronic Calculator

A new electron tube with amazing powers of "memory" has passed the development stage according to an announcement by Dr. Jan Rajchman of RCA Laboratories. Known as the "Selectron," this new tube is designed for use in electronic calculating machines through which, according to Dr. Rajchman, multiplication of two numbers of as many as twelve digits (one thousand billions) can be completed in about a hundred-millionth of a second.

Such super-fast calculations are important in solving mathematical problems relating to supersonic air flow, atomic physics, weather predictions, and other equations in which ultra-speed is a prime factor.

By its ability to retain data originally fed into the calculating machine and data subsequently accumulated in the calculating process, for arbitrarily long or short storing periods, the Selectron makes it possible to compute the long sequences necessary to eliminate the use of mechanical gadgets or humanly limited equipment.

Each of multiple "on-off" signals, representing factors of the mathematical operation, is stored in terms of electrostatic charges on the surface of an insulator. This is called "writing." Two sets of tiny metallic wires at right angles to each other are located between the source of electrons and the insulating surface, creating a checkerboard of windows which can be closed or opened to the passage of electrons at will.

The tiny metallic bars of the "windows" are internally connected so that by applying "on-off" voltages to a relatively small number of sealed-in leads, the flow of electrons can be blocked from all except one selected window. This selection is part of the "memory" characteristic of the tube. During so-called storing periods, electrons pass through all the windows and forcefully maintain the potential of subdivided areas on the insulator.

To register a signal during the bombardment of electrons, a specific window is opened to the exclusion of all others, and a voltage pulse is applied to a metallic plate backing the insulating surface. This pulse is negative or positive depending on the polarity of the signal and overpowers the local electronic locking mechanism. Then, all windows are again opened and the previously registered potentials are locked in. For reading any signal, the proper window is again opened to the exclusion of all others and a signal is obtained from the backing plate. The "writing" requires no previous erasing and takes only a few millionths of a second. The reading, which requires no scanning of undesired elements, follows the reading call by a few millionths of a second and can be repeated indefinitely.

The Selectron has a capacity of 4,096—equal to 64 squared—"on-off" signals. Dr. Rajchman disclosed that forty such tubes, with a capacity of 163,840 "on-off" signals will be used in an electronic computing machine being constructed for the Institute for Advanced Study.

Battery Specifications

Much favorable interest has been expressed by battery manufacturers in Signal Corps Specification No. 70-400, covering portable lead-acid storage batteries for Army procurement. Battery Branch, Squier Signal Laboratory, Fort Monmouth, prepared the specification and there have been indications that the industry would like to adopt it as a standard.

Copies of Specification 70-400 may be obtained from the Office of Technical Services, U. S. Department of Commerce, Washington, D. C. There is a small charge for the publication.

Byrd Expedition

A thorough test of the reliability of radio communications to regions of magnetic storms and ionospheric disturbances has been afforded by the Byrd South Pole Expedition. Only a few interruptions have occurred in the maintenance of 24-hour schedules between the Navy in Washington and the Mount Olympus, Admiral Byrd's communications ship.

There is a 9,200-mile span between Little America and Washington but the only complete blackout came on the day of arrival at the Bay of Whales, 15 January and lasted only one full day and part of the next.

Ninety per cent of traffic has been carried by radio teletype, which has been operable for a daily average of about 12 hours. Morse code was used at other times, with occasional relays through Samoa, Honolulu and Balboa, Canal Zone. During the first twelve weeks the Mount Olympus handled 16,000 messages. In January, the heaviest month, 215,000 words of press and nearly 200 radio photos were transmitted.

200,000-foot Parachute Descent

Army Ordnance and Air Forces have cooperated in the first successful launching of a ribbon-type parachute from the nose of a "WAC Corporal," U. S. liquid-fuel rocket developed at California Institute of Technology.

The parachute descent was designed to salvage the rocket and instruments for study—a difficult feat considering the 600-pound weight of a missile falling at 2,000 miles per hour.

The parachute was placed in the nose of the rocket and a clock-work mechanism was exploded, activating the release mechanism. At the top of the flight, as the WAC tilted to hurtle to earth, the parachute billowed out and lowered the rocket, which had consumed all of its fuel of nitric acid and aniline. Further similar experiments will be conducted in the spring.

SIGNAL CORPS NEWS

FROM THE CHIEF SIGNAL OFFICER

Octogenarian

The Signal Corps observed its 84th birthday on 3 March 1947, simultaneously with the 100th anniversary of the birth of Alexander Graham Bell. An Act of Congress dated 3 March 1863 established the Corps as a separate branch of the Army with Major Albert J. Myer as the first Chief Signal Officer.

The 84-year growth of the Corps has included expansion from visual flag signaling to multi-channel radio teletype communications and from 2,600 men to a 1945 wartime peak of 360,000. In addition to developing radio and wire military communications, the Signal Corps has provided pigeons, photography, cryptography and other services for the Army.

Educational Fund

In October 1944 the Signal Corps Educational Foundation was established with the purpose of providing financial aid to further the education of children of Signal Corps officers who had died while on active service. A balance of $12,388.38 remains in this fund and it is the desire of the Board of Trustees that the existence of the Foundation be made known so that assistance may be rendered in accordance with the by-laws of the organization.

Any one wishing further information should address an inquiry to the Treasurer, Colonel K. B. Lawton, Office of the Chief Signal Officer.

Baltimore Subdepot

Facilities of the former Glenn L. Martin Plant No. 2 at Middle River, Maryland, have been acquired and will function as the Baltimore Signal Subdepot under the administration of Holabird Signal Depot. All equipment and stores from the Philadelphia Depot are being transferred to the new installation.

Retirement

Brig. Gen. Frank E. Stoner, Acting Chief Signal Officer of the Army, has been retired from active duty at his own request, effective 30 April, and is now on terminal leave. General Stoner recently served as Chairman of the United Nations Telecommunications Advisory Committee and will accept a position as Chief Communications Consultant with that organization in the near future. He has a distinguished record in the Signal Corps, having been Chief, Army Communications Service during the war when that division was responsible for world-wide mlitary communications of the Army. He was designated Assistant Chief Signal Officer in December 1945 and Acting Chief Signal Officer on 31 January 1947.

Back to Japan

Replacing Major General Spencer B. Akin as Chief Signal Officer, U. S. Forces in the Far East, Brigadier General George I. Back has departed for his new assignment in Tokyo. He was formerly Chief Signal Officer, Mediterranean Theater and prior to the present appointment, Chief of the Army Communications Service.

Foreign Decorations

Three former Signal Corps Officers, all in the telephone industry, have been awarded the French Legion of Honor for wartime services. They are Brig. Gen. Carroll O. Bickelhaupt, Vice President of A. T. & T.; Colonel W. C. Henry, President, Northern Ohio Telephone Co.; and Colonel T. L. Frank, Equipment Engineer of the Northwestern Bell Telephone Company. General Bickelhaupt was made an Officer of the Legion and Colonels Henry and Frank were named Chevaliers.

The Legion of Honor, Officer Grade, has also been awarded to the following: Major General H. C. Ingles, Major General James A. Code, Jr., Major General W. H. Harrison, and Brigadier General Frank E. Stoner.

Medal For Merit

Dr. Edwin H. Armstrong, noted inventor in radio and Professor of Electrical Engineering at Columbia University, has been presented the Medal for Merit by Maj. Gen. Ingles, Chief Signal Officer. The citation, signed by President Truman, read in part: "Dr. Armstrong contributed greatly to the improvement and refinement of military radio communications by his numerous inventions in the field of radio, and by his unselfish and patriotic efforts as a voluntary advisor to the Chief Signal Officer of the Army on the military application of these inventions, particularly that of frequency modulation.

"He was instrumental in influencing the Army to adopt frequency modulation . . . and greatly facilitated production of this equipment by making his . . . patents available on a dollar-a-year royalty basis to anyone manufacturing apparatus for the War Department for military purposes."

1st Signal Company

Authorization has been given the 1st Signal Company, a unit of the 1st Infantry Division, to wear the French Fourrageres in the colors of the Medaille Militaire for operations in the European Theater in World War II. The Company has been credited for participation in three assault landings and eight campaigns during the war, one of the finest combat records among Signal units.

Weather

An automatic weather station will be installed at the Ainsworth Army Air Field, Ainsworth, Nebraksa, by the Meteorological Branch,Evans Signal Laboratory. The station will consist of an aneroid barometer for measuring the atmospheric pressure; a temperature-sensing element for measuring the temperature of the air; a human hair humidity element for measuring the relative humidity; an anemometer for measuring wind speed; a wind vane for determining wind direction; a rain gauge that indicates and totalizes the amount of rainfall; and a sunshine element to determine the relative brightness of the sky.

SIGNALS IN AGF

At 1330, Friday, 23 January 1947, the last vehicle of the 4th Signal Battalion completed bivouac on Fort Bragg's Smoke Bomb Hill and thus was concluded the permanent change of station from Fort Jackson, S. C., to Fort Bragg, N. C., that had for so long been the topic of conversation among the officers and men of the Battalion.

The completion of the move from Fort Jackson was the second major change to take place within the Battalion during the month of January. On the third of January the Battalion Commander, Lt. Col. Charles F. Crone was assigned to duty with the Signal Corps Schools at Fort Monmouth, New Jersey, and Lt. Col. Wayne P. Litz assumed command of the unit.

Colonel Litz served overseas as Division Signal Officer of the 37th Infantry Division in the Pacific Theater of Operations from 1942 to 1945. He returned to the United States in 1945 and, following his appointment to the Regular Army, was assigned as Division Signal Officer of the 82nd Airborne Division. From the 82nd, Colonel Litz was assigned his present duty as Commanding Officer of the 4th Signal Battalion.

Under their new commander, the Battalion became busily engaged in "bedding down" in their new station. Regular operations had to continue, areas and buildings had to be policed and signal schools had to commence as soon as possible. The members of the battalion used their time to advantage and things began to shape up rapidly.

After the unit was comfortably settled, plans for the organization and operation of the schools were given priority. Considerable quantities of "midnight oil" were consumed as procedures were prepared, studied, revised and then re-done. On Monday, 10 February 1947, less than three weeks after the Battalion had arrived at the new station, the schools were operating.

In the area set aside for that purpose, men were receiving instruction in Radio, Telephone, Teletype, AN/TRC Equipment, Radio Repair, Signal and Message Center Operations and Procedures, and Cryptography.

The schools were not limited to signal battalion personnel alone but were opened to all units of V Corps. In the near future the schools are expected to include men from the 82nd Airborne Division and other units in the Corps in their classes.

Company "A," the construction company of the Battalion, has two major projects under way. They are removing all poles from the North Camp Area of Fort Jackson and transporting them to Fort Bragg. They are also constructing a sixty-five mile pole line for AGF Board No. 1. This pole line will be used to test carrier equipment as well as some new construction specifications embodied in recent techniques.

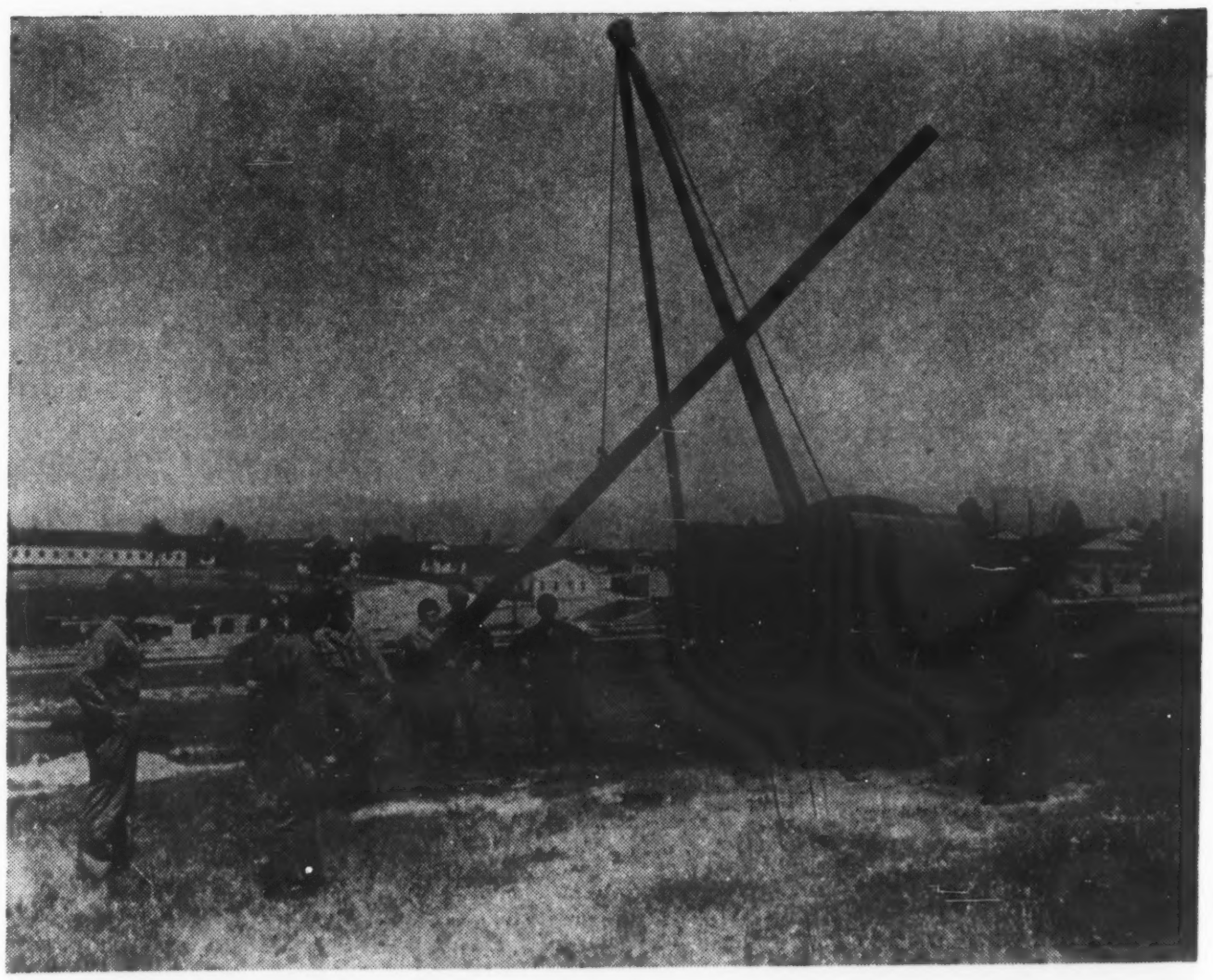
Company "B," the operations company, also is very busy. Not only does this company operate the Corps Message Center and Signal Center, but it also furnishes telephone communications within the Corps Headquarters and to nearby units.

Using the latest type AN/TRC equipment, the Battalion recently conducted an experiment to test the feasibility of establishing a relay station on Mount Mitchell, North Carolina. The problem was to determine whether or not a signal could be received from a commercial frequency modulated station located on Mount Mitchell, N. C., by an experimental station set up in the Smoke Bomb Hill area of Fort Bragg.

With standard Army equipment—Receiver R-19/TRC1, Antenna System AS 19B/TRC1 (eight sections, 40 feet high), and power generator PE-75—contact was established with the commercial station, which was using a transmitter with an output rating of one kilowatt and an antenna output of 300 watts. The distance was 184 air miles and signal strength on meter R-19/TRC1 was 30 microamperes, an equivalent rating of "R3."

●

Members of Co. A, 4th Sig. Bn., receiving instructions in use of K-43.



SIGNALS IN AAF

AACS In the War

Although Airways and Air Communications Service men were not considered combat personnel, the following excerpts from official files are indicative of their wartime exploits in all theaters:

At Munda an AACS unit went ashore in landing barges with the first wave of Marines. These men were the first AAF personnel ashore, and they made a new speed record in putting a radio station on the air to provide vital airways service for inbound aircraft carrying supplies and equipment . . .

The pilot of a B-24 lost his way on a flight from Newfoundland to Europe. When he reported his difficulty—30 minutes after he was due to land—AACS Atlantic D/F nets located the plane 700 miles southeast of its destination. Continual bearings were taken and the pilot was guided to the field. After three hours of flying, the bomber landed safely and without further mishap . . .

T/Sgt. John Swain, of Bakersfield, Mo., was one of the sixteen AACS men sent to Russia to install radio facilities for USSTAAF shuttle-bombing. They worked in a building, the basement of which was mined with five tons of German explosives. They tore out floorboards, installed electrical systems only a few feet from the cache until Russian demolition squads discovered the neatly concealed German booby-traps. Russians and Yanks vacated fast—left the mines to demolition experts . . .

At an AACS station, Crystal 2, located on Baffin Island, Canadian Northwest Territory, sixteen men and two officers lived for three months on corned beef hash and Vienna sausage when an Arctic storm held up delivery of food and supplies by air. The first plane-load of supplies to reach them consisted entirely of fresh head-lettuce. Lt. Fred T. Dickinson, officer in charge, exclaimed, "The men ate lettuce as if it were ice cream . . ."

At Henderson Field on Guadalcanal, AACS control tower personnel distinguished themselves by remaining on duty in the tower in order to aid friendly aircraft during times when they were free to seek the shelter of fox-holes. Abandoning their posts would have endangered our planes . . .

In Africa and Italy AACS units established stations immediately following Allied capture of airdromes and landing strips. In France they paced the advance in mobile units to provide communications for Troop Carrier Command. One of the most exciting AACS exploits took place along a small airstrip at Myitkyina, Burma. Our men landed on the strip while the battle was still in progress. Hundreds of planes were en route to land there and it was our job to get them in safely, despite constant enemy fire. The only material which could be used for a control tower was a few discarded packing cases. Later, a transport plane cracked up at the end of the runway and the AACS men moved in and started controlling traffic from there. Jap artillery and rifle fire rattled all around them constantly but they delivered the goods. All 22 of those AACS men were awarded the Bronze Star for meritorious service.

GCA

Major General Harry Vaughan, President Truman's military aide, credits AACS-operated GCA equipment with a "save." The General was aboard an Army C-47 en route to Bremen, Germany, when the pilot was notified that the field there was closed because of pea-soup fog.

After circling around at 1,000 feet the pilot called Bremen again and after reporting that the fog was thickening, asked advice for landing. The Bremen radio operator remembered that the Nordholz airfield had GCA equipment and the plane was directed to proceed there.

Then GCA took over. With terse, clear statements, the approach controllers, seated before their radar scopes inside a darkened trailer on the runway, brought the pilot on the right course, and turned him over to the traffic controller. Then a calm, authoritative voice took over, and with reassurement correlated with course bearings, he finally said, "The runway is directly in front of you . . . OK—you're on the ground!"

When the General and his fellow passengers debarked from the plane someone noticed that their handkerchiefs were slightly dampened. And, in the words of the pilot of the ship: "That GCA operator ought to have his own personal pair of wings and be drawing flight pay. For he was sweating just a little, too!"

The AAF will have 56 radar GCA units in operation by next summer at airbases in this country and overseas, and every major AAF installation in this country and most of the foreign fields could be similarly equipped with this device if trained personnel were available to operate the units.

Maj. Gen. H. M. McClelland, Commanding General of AACS, recently disclosed that approximately 190 GCA Mark II units were delivered to the AAF during the war. Since the war, several 1946 Mark III models have been delivered and turned over to CAA for use by civilian airlines at Washington, New York and Chicago. However, there are still about 130 Mark II GCA units in storage, immobilized because of the lack of trained radar operators. About six months are required to train a qualified GCA operator.

Bombsight

Norden Bombsight Number 4120, used when the Army Air Forces dropped the first atomic bomb on Hiroshima, 6 August 1945, was presented to the Smithsonian Institution in Washington in a ceremony on 10 February.

NOTES FROM FORT MONMOUTH

Dr. Smyth

Brig. Gen. Jerry V. Matejka, Commanding General of Fort Monmouth, and members of his staff were recent dinner hosts to Dr. Henry DeWolf Smyth, Chairman of the Department of Physics at Princeton University and consultant on the Manhattan Project. The luncheon followed Dr. Smyth's lecture to post personnel, in which he told of his recent and much-discussed book, *Atomic Energy for Military Purposes,* written at the direct request of Maj. Gen. Leslie R. Groves, Commanding General of the Manhattan Project. Professor Louis F. Rahm, Associate Professor of Mechanical Engineering, and Dr. Clodius H. Willis, Dean of Electrical Engineering, both of Princeton, accompanied Dr. Smyth to Ft. Monmouth.

Special Services

Effective 15 February, the Special Services School of the Army was established at Fort Monmouth and will function under the supervisory control of the Chief of Special Services, War Department. Establishment of the school is in line with the recent authorization of the Office of the Chief of Special Services as a permanent part of the post-war Army, with appropriate allotments of officers for details of three-year periods.

Courses will include the Army Exchange Officers' Course, Exchange (Civilian) Managers' Course; and a course for Special Services Officers and Enlisted Personnel. Army-wide functional responsibilities of the Office of the Chief of Special Services include the Army Exchange Service, the Army Recreational Service and the Army Motion Picture Service.

SCEL

Lt. Col. Marshall D. Barr has recently been appointed Director of Administration for the Signal Corps Engineering Laboratories, replacing Colonel Paul Neal, now Executive Officer for SCEL. Colonel Barr became executive officer of the Electronic Training Group in England in July 1942 and his subsequent service included 44 months in overseas theaters.

Inspection

Major General Henry S. Aurand, Director of Research and Development for the War Department General Staff, made an inspection tour of the Signal Corps Engineering Laboratories on 29 January. He visited Squier, Coles and Evans Signal Laboratories, accompanied by Col. J. D. O'Connell, Deputy Commander for Research and Development, SCEL. General Aurand later attended a luncheon in his honor at the Officers' Club on the main post.

Scientists

A group of internationally known scientists, all outstanding in the fields of piezo-electricity, mineralogy and electronics, visited Squier Signal Laboratory on 28-29 January. Many of the savants were members of the group formed early in 1942 which played so large a part in expanding the crystal industry from an output of 100,000 units per year before Pearl Harbor to 28,000,000 in 1944. The visitors included Doctors Harrison and Mingins of Tufts, Van Dyke of Wesleyan, Frondel and Hurlbut of Harvard, Gruner and Hartig of Minnesota, Edson of Georgia Tech, Pepinsky of Alabama, Swinnerton of Antioch, Stoiber from Dartmouth, Lukesh and Washken of M. I. T., Gordon from the Academy of Natural Sciences at Philadelphia, and Parrish from Phillips Laboratories.

The Signal School and AAF

Arrangements were recently completed between the Signal Corps and the Army Air Forces to train 1,200 AAF enlisted men at the Signal Corps School at Monmouth. The men began arriving on 3 February, after which time they will be sent in increments of 150 per week for eight weeks. The AAF personnel will specialize in communications and are attending classes in all sections of EMS.

A Bird's Life

Monmouth's loft houses what is probably the oldest pigeon in the world. *Kaiser,* famous carrier captured from the Germans in World War I, is well and happy at 30, an age equivalent to 145 among humans. Normal pigeon life-span is five to eight years but *Kaiser* begins to show signs of immortality.

The grizzled feather-merchant has sired between 80 and 100 offspring during his lifetime, which must also be something of a record. Climactically, he became a father again recently. His mate, *Lady Belle,* is a mere chick beside her super-annuated husband.

Educatory Program

In a further move to fulfill the policy of making the American soldier the "best educated and informed in the world," the Information and Education Branch at Ft. Monmouth has convened the first classes in the new Off-Duty Education Program, the first in two years. Elementary Spanish, plane trigonometry and algebra were the three courses that initiated the new program. They were chosen by popular request.

W20EC Calling CQ

Fort Monmouth's Radio Club is operating regularly on the amateur bands with the assigned call, W20EC. U. S., South American, European and African stations are worked regularly and a schedule is maintained with one American ham in Germany.

Any soldier holding a valid FCC operator's license may operate the equipment and classes in code and theory are being conducted to prepare aspirants for the Government examinations. A lively interest is being shown in both the station operation and the classes.

W20EC operates on 10, 20, 40 and 80 meters, using BC-610 transmitters and a Hallicrafters SX-28-A receiver. Captain A. Santelli is in charge, assisted by Master Sergeant Albert Leeds, T/5 Albert Martin and Pvt. Robert Becker.

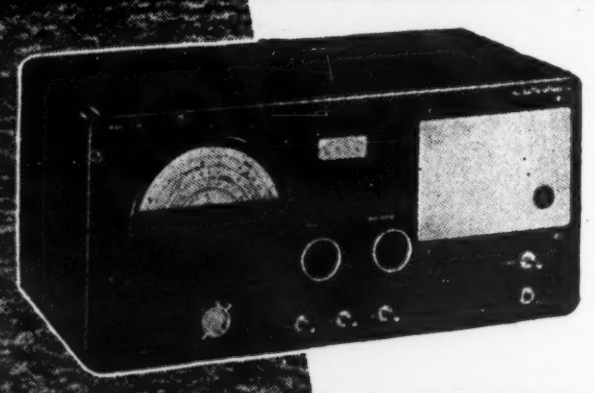
Going places (AGAIN)

hallicrafters

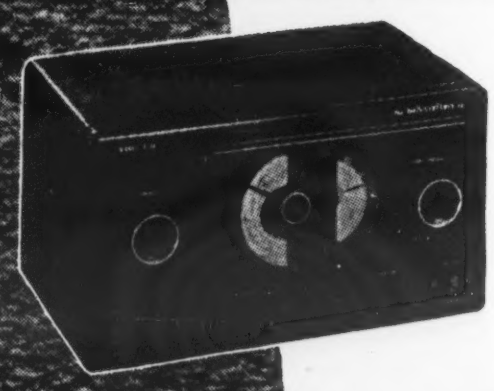
Hallicrafters famous radio equipment, sold and distributed around the world before the war and used with superb effectiveness in every theater during the war is once again on the move. Watch for latest details of the Gatti-Hallicrafters mobile radio equipped expedition to the Mountains of the Moon in deepest Africa—a new and exciting test for the ingenuity of hams and the performance of Hallicrafters equipment.

3 GREAT RECEIVERS designed and built FOR HAMS WHO LIKE TO COME OUT ON TOP

***Model* SX-42** Described by hams who have operated it as "the first real postwar receiver." One of the finest CW receivers yet developed. Greatest continuous frequency coverage of any communications receiver—from 540 kc to 110 Mc, in six bands. FM-AM-CW. 15 tubes. Matching speakers available. **$275.00**

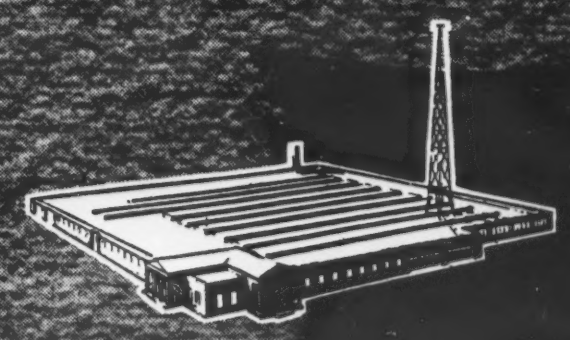


***Model* S-40A** Function, beauty, unusual radio performance and reasonable price are all combined in this fine receiver. Overall frequency range from 540 kc to 43 Mc, in four bands. Nine tubes. Built-in dynamic speaker. Many circuit refinements never before available in medium price class. **$89.50**



***Model* S-38** Overall frequency range from 540 kc to 32 Mc, in four bands. Self contained speaker. Compact and rugged, high performance at a low price. Makes an ideal standby receiver for hams. CW pitch control is adjustable from front panel. Automatic noise limiter..... ..... **$47.50**

Prices slightly higher in zone 2



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NATIONAL GUARD AND R.O.T.C.

ORC Training

A new plan for Organized Reserve raining, developed by the War Department, meets the requirements for ntensified training yet permits participation in accordance with the amount f time a Reservist has available.

Three types of Reserve units are rovided for. Class A units will be ombat and service units, for the M-Day force only, organized with a full omplement of both officers and enisted personnel. The Class A units ill be fully equipped and trained, orrecting the deficiency of pre-World War II procedure, which allowed only fficer personnel and denied the Reerve officer the opportunity to gain eadership training on a continuing asis. Most of these will be service nits.

Class B units will be organized with ll, or a part, of their complement of fficers and an enlisted cadre.

Class C units will be organized with ll, or a part, of their complement of fficers only.

Reserve Officers

Under the new system every Reserve Officer must take an active part in the ORC program to remain in the Active Reserve. If not he will be placed in the Inactive Reserve, where training and promotion will not be given. The AGF plan provides Reserve Officers the means of maintaining and furthering their military qualification by active duty, attendance at service schools and Army extension courses.

Signal Units

Organized Signal Reserve units that have already been activated by the War Department are as follows:

Class A: 811th Sig. Co. (Engr. Spec. Brig.), Los Angeles, Calif.; 79th Sig. Co., Philadelphia, Pa.; 83rd Sig. Co., Cleveland, Ohio; 85th Sig. Co., Peoria, Ill.; 159th Armd. Sig. Co. (19th Armd. Div.), Los Angeles, Calif.; 77th Sig. Co., New York, N. Y.; 80th Airborne Sig. Co., Richmond, Va.; 90th Sig. Co., San Antonio, Texas.

Class B: 300th Sig. Hvy. Cons. Co., Kansas City, Kans.; 806th Joint Assault Sig. Co., Chicago, Ill.; 805th Sig. Depot Co., Decatur, Ill.; 814 Sig. Serv. Co. (Long Lines), Omaha, Nebr.; 815th Joint Assault Sig. Co., Chicago, Ill.; 94th Sig. Co., Boston, Mass.; 98th Sig. Co., Buffalo, N. Y.; 87th Sig. Co., Birmingham, Ala.; 307th Sig. Hvy. Cons. Bn., Cincinnati, Ohio; 819th Sig. Serv. Co. (2nd Army), Richmond, Va.; 157th Armd. Sig. Co. (22nd Armd. Div.), Dallas, Texas.

Class C: 302nd Sig. Hvy. Cons. Bn., Louisville, Ky.; 812th Sig. Depot Co., Wilmington, Del.; 813th Sig. Serv. Co. (Radio Relay), Minneapolis, Minn.; 301st Sig. Radar Mtce. Unit (G), Albuquerque, N. Mex.; 302nd Sig. Radar Mtce. Unit (G), Chicago, Ill.; 89th Sig. Co., Wichita, Kans.; 100th Airborne Sig. Co., Louisville, Ky.; 78th Sig. Co., Newark, N. J.; 155th Sig. Co. (21st Armd. Div.), Detroit, Mich.; 818th Sig. Serv. Co. (Long Lines), Covington, Ky.; 817th Sig. Serv. Co. (Fixed Radio), Lexington, Ky.; 303rd Sig. Radar Mtce. Unit (G), Pennsylvania State College; 306th Sig. Hvy. Const. Bn., Springfield, Ill.; 104th Sig. Co., Portland, Ore.

ORC Generals

First general officers in the ORC were recently approved by the Senate. Signal Corps appointees were: Maj. Gen. William H. Harrison, Vice President and Chief Engineer, A.T.&T.; Brig. Gen. Carroll O. Bickelhaupt, Vice President, A.T.&T.; Brig. Gen. Ephraim F. Jeffe, Vice President, Consolidated Edison Co. of New York; Brig. Gen. Charles E. Saltzman, Vice President and Secretary, New York Stock Exchange; Brig. Gen. David Sarnoff, President, RCA and Army Signal Association; and Brig. Gen. Samuel M. Thomas, Electrical Engineer, College Park, Georgia.

ROTC

General J. L. Devers of AGF has announced plans for resumption of ROTC summer training, suspended since 1941. The courses are tentatively scheduled for six weeks and will be conducted at selected camps throughout the United States. Students in the Advanced Course of the Senior ROTC will attend at least one of the summer camp sessions as a required supplement to regular training. Attendance will normally be during the summer preceding the final year of college.

In camp students will receive $75 per month and necessary travel at five cents per mile. Approximately one-half of the training period will be devoted to subjects common to all branches with the remainder involving tactics and techniques of individual branches. The training will consist of either five 8-hour days, or four 8-hour days and two 4-hour days, at the discretion of the camp commander.

Texas Tech

The 4508th ASU Signal ROTC Unit at Texas Technological College is progressing rapidly in training with an enrollment of 23 students. Major John M. Goodman, S.C., is in command, assisted by 1st Sgt. John B. Larrimer. The present curriculum includes Message Center and Signal Center Procedure. The men are intensely interested in unit activities: the allocation of the 6-meter radio band for practice in radiotelephony, the organization of a student chapter of the Army Signal Association, and the forthcoming military ball.

Freshmen are predominant within the unit because of their service in the armed forces and have entered the advanced stage of ROTC along with the upper classmen who are in the same category. The Navy is well represented as well as almost all other Army branches.

During the war, over 800,000 men in uniform enrolled for courses in the United States Armed Forces Institute, and over 4,000,000 texts were distributed for classroom instruction.

Pi Tau Pi Sigma

Nearly a quarter of a century ago the national honorary and professional Signal Corps fraternity, Pi Tau Pi Sigma, was organized to establish, foster and preserve the spirit of fellowship among advanced Signal Corps ROTC students. Chapters were located at all but one of the universities having Signal units, extending from the University of California to M.I.T. Liaison was established by a monthly magazine, an amateur radio net, and a national convention and banquet held annually during ORC summer encampment.

With the threefold increase in Signal Corps units in colleges, interest has been manifest by schools not now possessing a chapter charter. For those desiring additional information, write the Executive Secretary, Army Signal Association.

National Guard

A six-year training program for National Guard units has been planned, with Army Ground Forces completing the first two years in detail. The plan will be put into operation by National Guard commanders all over the country when individual organizations reach the required percentage of authorized officer and enlisted strength.

Under the overall objective of standardizing the training of units in every state, detailed instructions will be provided for the training of individuals and units on a company level during the first and second years. Other plans will deal with training on a battalion level during the third and fourth years, on a regimental combat team and combat command level during the fifth year, and on a division level during the sixth year.

A special course of instruction has been drawn up for each of fourteen types of units: Antiaircraft Artillery, Armored, Band, Cavalry, Chemical, Seacoast Artillery, Engineer, Field Artillery, Infantry, Medical, Military Police, Ordnance, Signal, Quartermaster and Transportation Corps. Each course is based on a minimum of 96 hours per year of armory training and a minimum of 92 hours per year of summer training. Troop schools will be conducted during the armory period.

Committees

The War Department General Staff Committees on National Guard and Reserve Policy have held several sessions in Washington. They have convened by order of Secretary of War Robert P. Patterson to study problems connected with the Reserve and National Guard components of the post-war Army.

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BOOK SECTION

SCIENTISTS AGAINST TIME, by James Phinney Baxter, III. Little Brown & Co. 460 pages. $5.00

This book throws open the heretofore closed files of the Army, Navy, NDRC (National Defense Research Council) and Office of Scientific Research and Development, and tells the part American scientists played in winning World War II in a Jules Verne type of novel.

Radar, proximity fuzes, atom bombs, Manhattan Projects, DUKWS and penicillin are familiar words which the American public learned during the war years. In an understandable manner the writer has clarified these terms and given a detailed record of the wartime research on these subjects which, besides being good reading, is a factual record of accomplishment. Especially timely is the revelation of the difficulties encountered by the drafting and enlistment of scientists in the Armed Forces. The varying views of some government officials on this subject and the requirements of a National Service Act under which the individual would have been placed in the position for which he was best fitted and which would have most benefitted the nation, is ably brought out.

The ever continuing race between the belligerents during World War II for scientific supremacy and our moves in this master chess game of science are clearly portrayed. Our military leaders were called upon to change both their strategy and tactics due to the work of these men. As Mr. Baxter states, Winston Churchill's words after the Battle of Britain apply equally well to the scientists of the Allied nations.

F. P. R.

AMERICAN FORCES IN ACTION, Historical Division, U. S. War Dept. Eight monographs, illustrated, maps.

"In the thick of battle, the soldier is busy doing his job. He has the knowledge and confidence that his job is part of a unified plan to defeat the enemy, but he does not have time to survey a campaign from a foxhole. If he should be wounded and removed behind the lines, he may have even less opportunity to learn what place he and his unit had in the larger fight.

"*American Forces in Action* is a series prepared by the War Department, especially for the information of wounded men. It will show these soldiers, who have served their country so well, the part they and their comrades played in achievements which do honor to the record of the United States Army." This is General Marshall's preface to this series of monographs.

Eight of the series have been published—all excellent, well illustrated battle narratives, based on the best military records available. Six more pamphlets are scheduled for release before Spring, at which time the final histories will appear.

Present titles which are available from the Government Printing Office in Washington are:

To Bizerte With the 11 Corps—the North African Campaign	$ .45
Papuan Campaign—the Buna-Sananda Operation	.50
Salerno — American Operations from the Beaches to Volturno	.55
Volturno—From the Volturno to the Winter Line	.35
The Winter Line—Gen. Clark's 5th Army in North Italy	.25
Merrill's Marauders—the Famous Composite Unit in No. Burma	.40
The Admiralties—Operations of the 1st Cavalry Division	.40
Omaha Beachhead and the Normandie Invasion	1.50

THE OFFICIAL PICTORIAL HISTORY OF THE AAF. Duell, Sloan and Pearce. 213 pages. $10.00

Here is a faithful record of the spectacular growth of U. S. military aviation from the first use of lighter-than-air balloons as the aerial eyes of our Civil War armies. The first of an excellent selection of official photographs shows Lowe's captive balloon above the York River in 1862. From then on the book is an easily read and understood account of the slow and difficult progress of military aviation. It is interesting to note that efforts to develop aircraft for use in our armies were retarded in the earlier days by the same obstacles that exist today in military preparedness: lack of interest by the public, failure to appropriate funds by Congress and the traditional refusal to listen to military leaders and planners in peace time. Aviation activities for the Army were not placed on a firm footing until 30 years after the first balloon was used in the Civil War—in 1892 when a balloon section of the Signal Corps was established by the then Chief Signal Officer, General Greely.

But it was another 15 years before the Army Air Forces got their real start in the detail of two enlisted men as the entire Aeronautical Division of the Signal Corps. It is here that the names, which in World War II were to make headlines, began to appear. The accomplishments, the vision, the determination and the courage of Generals Arnold, Spaatz, Eaker, Doolittle, Selfridge, Lahm, Olds, Mitchell, Kenney, et al., are traced by descriptions of their exploits.

The price of $10 would be excessive if it were not for the fact that all royalties are to go to the Army Air Forces Aid Society.

S. H. S.

RADAR—WHAT IT IS, by John F. Rider and G. C. Baxter Rowe. John F. Rider, Inc. 72 pages. $1.00

The authors of this pamphlet were both former officers in the Signal Corps and both are well known in technical publishing. The brochure explains and describes, in readily understandable language and without the use of mathematics, the underlying principles of radar, the components of a radar set, types of antennas and indicators, and means of using radar equipment on the ground, in the air and at sea. Also included is a brief chapter covering use of identification equipment (IFF) with radar and radar countermeasures.

To those who are not familiar with radar and who have been promising themselves to find out what it is but who simply cannot find the time to read the usual lengthy books on the subject, this publication should prove a boon. For those already familiar with radar equipment of one type, this pamphlet offers a brief insight as to its use by other services. In view of the recent outburst of criticism in connection with aircraft accidents, the section on ground controlled approach, GCA, equipment should be of interest.

The reader will find explanations for such terms as A, B, C, J, and PPI scopes, GIC, AI, ASV, GCI, waveguide, magnetron, etc. Interesting stories on the use of radar in combat are interspersed throughout to show some of the practical uses to which the equipment being described was placed.

N. A. A.

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COMMAND DECISION.
By William Wister Haines, 258 pages. Little, Brown, $2.50

Here is something different in war heroes—a young Air Force brigadier general—a West Pointer—who has spent most of his adult life preparing himself to make the decisions he now has to make every day—decisions which may send many of the combat men of the 15,000 officers and men of his command out to face sudden and terrifying death. Among these is his closest friend. It is a welcome change to find a book which does not assume at the start that courage and other soldierly qualities are more likely to exist in the soldier of low rank. A very real and intensely interesting picture is drawn of some of the conditions that combat leaders had to face daily. Conscientious, overworked General "Casey" Dennis has a Division of B-17s with extra fuel capacity that increases their range to permit striking Nazi factories that are just commencing to make a new secret jet plane. But the factories are located far beyond fighter escort range, which means almost certain high losses both coming and going. But "Casey" is certain that if production of the jets is not stopped, and at once, this new and superior enemy fighter will win mastery of the air from us and make daylight precision bombing impossible. His every thought is guided by the rule that he is responsible for "making his command inflict maximum injury on the enemy within orders." And so he makes his command decision which requires three successive daily missions. After the first raid forty planes and 400 men are missing. The author's description of the return to base of the survivors is excellent but his detailed description of the frenzied yet ordered activity on a bomber base in Britain before a group takes off is really stirring. There is plenty of humor, especially in the activities of Sgt. Evans, the General's chief clerk, who like so many others "concealed unfathomable depths of loyalty even hero worship under their studied toughness." There is enough criticism of some military procedures to make certain that the author has no desire to glamorize "the brass," and enough unvarnished "barracks language" to qualify it as an outspoken post war novel.

SHS

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Book Service

Our Book Department is prepared to supply, in limited quantity, any book currently in print. Send us the name of the book, the author and, where possible, the publisher, and your order will receive immediate attention. If accompanied by check or money order the book will be sent postpaid. A 10% discount is allowed on all orders of $2.50 or more. COD orders will include mailing cost.

May we offer the following suggestions:

RADIO

MODERN RADIO SERVICES, by Alfred A. Ghirardi, Murray Hill Books, Inc. 5.00
RADIO PHYSICS COURSE, by Alfred A. Ghirardi. Murray Hill Books, Inc. 5.00
TELEVISION: THE EYES OF TOMORROW, by Captain William C. Eddy. Prentice Hall 3.75
TELEVISION TECHNIQUES, by Hoyland Bettinger. Harper & Bros. ... 5.00
TELECASTING AND COLOR, by Kingdon S. Tyler, Harcourt, Brace & Co. 2.75

PHOTOGRAPHY

FREE LANCE PHOTOGRAPHY, by Townsend Godsey, Duell, Sloan and Pearce $4.00
U. S. CAMERA ANNUAL——1947, U. S. Camera Publishing Corp. .. 5.75
FUNDAMENTALS OF PHOTOGRAPHY, by Paul E. Boucher. D. Van Nostrand Co., Inc. 4.00
HOW TO DEVELOP, PRINT AND ENLARGE PICTURES, by Samuel Epstein and David W. DeArmand Franklin Watts, Inc. 1.25

GENERAL

THE EVOLUTION OF MODERN PHYSICS, by Carl Trueblood Chase. D. Van Nostrand Co., Inc. $2.50
APPLIED MATHEMATICS FOR ENGINEERS AND PHYSICISTS, by Louis A. Pipes. McGraw Hill 5.50
THE FAMOUS EDDY REFRESHER IN FUNDAMENTAL MATHEMATICS, by Capt. Wm. C. Eddy & Associates. Prentice Hall 1.40
SCIENCE YEARBOOK OF 1947, edited by J. D. Ratcliff. Doubleday & Co. 2.50
CONCISE CHEMICAL AND TECHNICAL DICTIONARY, edited by H. Bennett. Tudor Publishing Co. 10.00
BUSINESS BUDGETING AND CONTROL, by J. Brooks Heckert. The Ronald Press 5.00
APPLIED ATOMIC POWER, by Smith, Fox, Sawyer and Austin. Prentice Hall 4.00
THE STRANGE ALLIANCE, by John R. Deane. Viking Press. 3.75
EAST OF THE IRON CURTAIN, by Wm. Van Narvig. Ziff Davis Publishing Co. 3.00
OPERATIONS IN NORTH AFRICAN WATERS, by Samuel Eliot Morrison. Little Brown & Co. 5.00
NUREMBERG DIARY by G. M. Gilbert. Farrar, Straus & Co., Inc. 4.50
HIROSHIMA, by John Hersey. Alfred A. Knopf 1.75
THE PHILOSOPHY OF WAR AND PEACE, by Albert C. Knudson. Abingdon-Cokesbury Press 2.00
MY LIFE STORY, by Joe Louis. Duell, Sloan & Pearce 2.75
THE LINCOLN READER, edited by Paul M. Engle. Rutgers University Press 3.75
AIR CONDITIONING, by Samuel P. Brown. McGraw-Hill 5.00
ATOMIC ENERGY, by Dr. R. R. Nimmo. Pilot Press, Inc. 2.00

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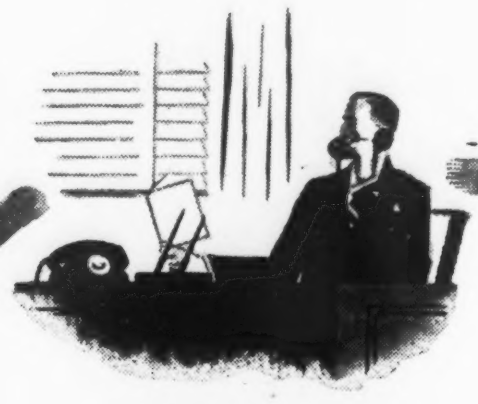
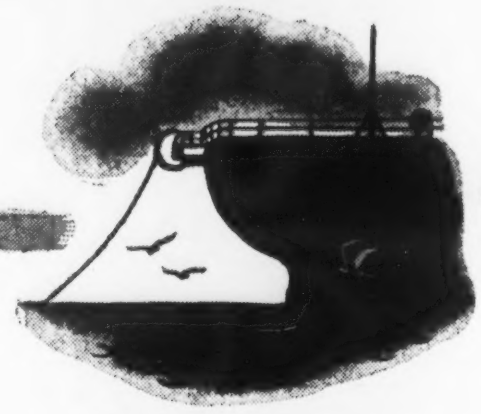


TELEPHONE OPERATIONS

I T & T has modernized and expanded national telephone networks in many countries, owns and operates 7 systems in Latin America and Shanghai, China.

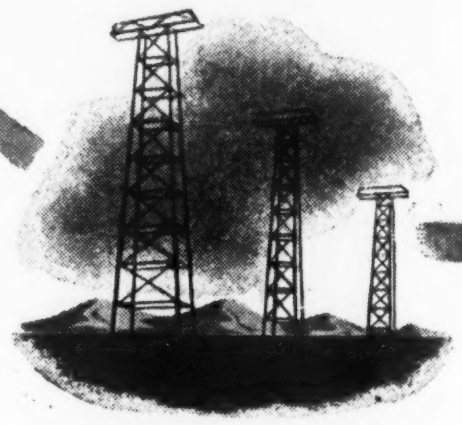
MANUFACTURE OF COMMUNICATIONS AND ELECTRONIC EQUIPMENT

I T & T factories in 26 countries, sales offices in many more, make it the largest international communications and radio supplier.



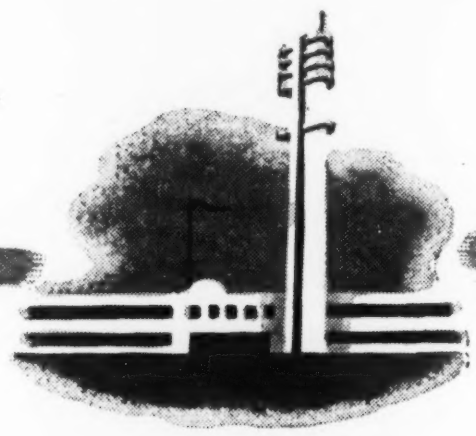
CABLE AND RADIOTELEGRAPH COMMUNICATIONS

I T & T associates have 47,000 miles of submarine cable, 6600 miles of landline connections, over 60 international radiotelegraph circuits.



RADIOTELEPHONE COMMUNICATIONS

I T & T has installed and operates the radio stations connecting most of the countries of Latin America by radiotelephone with 95% of the telephones of the world.

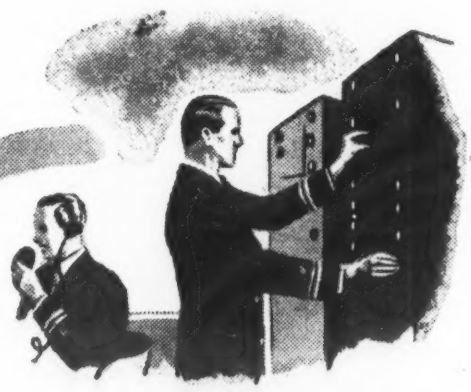


RESEARCH AND DEVELOPMENT

I T & T research and development activities have been responsible for an outstanding record of contributions in the field of communications as well as electronics.

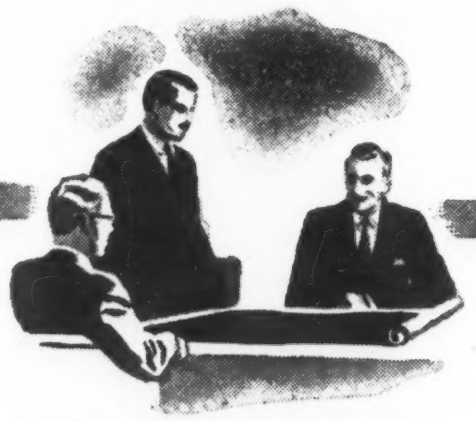
RADIO AIDS TO AERIAL NAVIGATION

I T & T companies, world-wide pioneers in radio navigation research, are today manufacturing and further developing electronic aids for safety in air transportation.



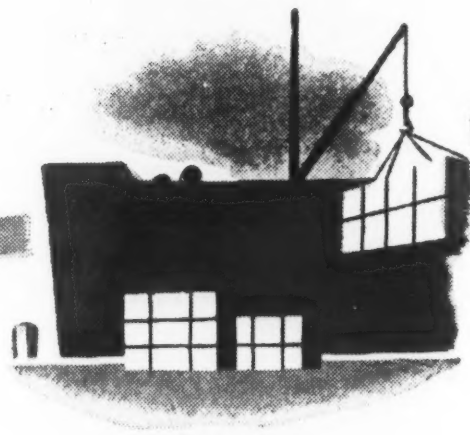
MARINE COMMUNICATIONS SALES AND SERVICE

I T & T associates operate 7 U. S. marine communications shore stations and have 152 sales-service agencies at principal world ports.



TECHNICAL AND ADVISORY SERVICES

I T & T technical and advisory services are supplied to certain government telephone systems as well as to privately owned telephone operating enterprises.



EXPORT

I T & T maintains an export department which supplies its customers their complete requirements of electrical equipment, including products of other manufacturers.

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84th Anniversary

The Honorable Robert P. Patterson, Secretary of War, was the guest speaker at the Washington Chapter luncheon meeting held on Monday, March 3, at the Mayflower Hotel main ballroom, in observance of the 84th Anniversary of the ARMY SIGNAL CORPS.

The Secretary of War was introduced by Brigadier General Frank E. Stoner, Acting Chief Signal Officer, to the two hundred guests, including many notable figures in business and military circles.

Mr. Patterson stated that "this is a memorable date in communications history. One hundred years ago today, Alexander Graham Bell, inventor of the telephone, was born in Edinbough, Scotland. Eighty-four years ago today, the Army Signal Corps was created as a special branch of the Army. And on the same date—March 3, 1863, there was created in the Army a new pioneering spirit in scientific research and development that has been of lasting benefit to America in peace as well as in war."

"Working together, the Signal Corps and private industry . . . advanced this nation not only in communications but in other fields of paramount importance," said the Secretary of War.

Patterson continued:

"The part played by the Signal Corpsman in the war cannot be overemphasized. In this country and overseas he provided the technical ability without which victory would have been impossible. In combat, Signal Corps soldiers stormed the beaches in Europe and the Pacific, strung their wires or trained their cameras under enemy fire, died with the infantry in the advance against the Nazis and the Japs."

Patterson then acclaimed the work of Major General H. C. Ingles, who retires 31 March 1947. "He made one of his most important contributions to the work of the Signal Corps after the war, by reemphasizing research and development as a major phase of the Corps' activities. General Ingles will be succeeded by Major General Spencer B. Akin, whose nearly thirty years as a Signal Officer are high-lighted by his work as Chief Signal Officer for General Douglas MacArthur in the Pacific. I can assure you that he has the progressive attitude of his predecessors."

Patterson concluded by saying: "It bolsters one's assurance of the future progress of the Signal Corps to talk to you as I have this noon, because I know that the Army Signal Association, and the Washington Chapter, are so vitally interested in that progress, I have confidence—and the entire Signal Corps shares that confidence—that you of the Army Signal Association will support the Corps fully in each of these functions."

Among the two hundred in attendance were Mr. J. B. Morrison, Vice President, C & P Telephone Company and Interim President of the local chapter, who presided. Captain Harry E. Fisher, Secretary and founder of the Charter, was in charge of arrangements. His initiative, energy and drive were responsible for the success of the meeting.

Army-Industry Military Communications Day

April 29 is the "Day" for the first annual Convention and Exhibition of ASA at Fort Monmouth, New Jersey, and it also commemorates Army-Industry Military Communications Day. Leaders in communications and photographic industries will be among the five hundred or more expected to attend this meeting. And the annual banquet will be held in New York City on the evening of 28 April.

Chapter News

Cleveland

On the 20th of February Brigadier General S. H. Sherrill, Executive Secretary of ASA, presented the Cleveland Chapter with its Charter, and addressed the members on the "Aims of the Army Signal Association." Motion pictures were shown, too, at this second monthly meeting, followed by refreshments.

Colonel Lee J. Shaffer, wartime head of Enlisted Men's School at Fort Monmouth, was elected President.

Sacramento

Out in California the Sacramento Chapter was presented with its Charter by Brigadier General C. H. Arnold at a special meeting on the 20th of February at the Sacramento Signal Depot. Nominations of officers took place at this meeting.

Decatur

Decatur Chapter is set and busy getting things under way since receiving their Charter. The most recent meeting was held at the Decatur Signal Depot, and Mr. L. L. Thomas, of Bell Telephone Company, was guest speaker. A motion picture showing the laying of telephone cable across the mountains and deserts of the West, and the development of the ticker-tape system was shown.

The following officers and board of directors were elected: Colonel John L. Leidenheimer, President; Emerson A. Shultz, 1st Vice President; E. M. Schaudt, 2nd Vice President; W. R. Winn, Treasurer; Edward C. Whitcomb, Secretary. Board of Directors: two year term—George V. Miller and L. L. Thomas; one year term—Professor William L. Everitt, Major James D. Nutt, and Major George I. Bradford, Jr.

Student Chapters

West Point

Colonel Kenneth F. Zitzman, recently appointed associate Professor of Electricity, and Colonel Walter B. Bess, appointed Assistant Professor of the same department, at West Point, report satisfactory progress in forming a chapter of 1st Class Cadets and officers interested in communications.

Group and Life Members

The following organizations have become Group Members of ASA since the last issue of SIGNALS:

Heinemann Electric Company
Jacobsen Manufacturing Company
Mines Equipment Company
Willard Storage Battery Company

New Life members of the Association are:

Captain James E. Foster
Captain Arthur B. Gibson
Lt. Col. John G. Johnson
Lt. Albion W. Knight
Lt. Col. George W. Ryne
Lt. Col. William Buell Scace
Captain James F. Scoggin, Jr.
Major Eugene E. Skinner

Army Signal Association
CONSTITUTION

ARTICLE I

NAME AND OBJECTIVES

SEC. 1. The name of the Association shall be "Army Signal Association." When and if the Air Forces are no longer a part of the Army the name shall be changed to a designation appropriate to the Association's purpose of serving the interests of the Army and the Air Forces and perhaps the Navy.

SEC. 2. The Association shall be a patriotic, educational, scientific, and non-profit-making organization of American citizens, dedicated to scientific, industrial and military preparedness for the common defense, thus contributing to national security and peace.

SEC. 3. The executive offices of the Association shall be in the city of Washington, District of Columbia.

ARTICLE II

MEMBERSHIP

SEC. 1. Membership in the Association shall be open to all men and women who are American citizens and who are interested in furthering the objectives of the Association as set forth in this Constitution and in the By-laws. The classes of membership and the fees therefor shall be as prescribed in the By-laws.

ARTICLE III

GOVERNMENT AND OFFICERS

SEC. 1. The government of the Association shall be vested in its officers, a Board of Directors and an Executive Committee thereof. The Board of Directors shall be elected by a majority vote of the members of the Council.

SEC. 2. The Council shall have the sole function of electing the Board of Directors of the Association. It shall consist of (1) one member elected for a period of one year (or until his successor is chosen) by and representing each chapter, (2) the three immediate past presidents, (3) the current national officers and national directors, and (4) five members at large to be elected for a period of one year by the existing Council. The Council shall choose its own chairman and vice-chairman and shall have power to fill unexpired terms of its members. It shall meet at the call of its chairman but, if necessary, its business may be transacted by letter.

SEC. 3. The officers shall consist of a President, a First Vice President, a Second Vice President and such additional numbers of Vice Presidents, not to exceed three, as may be authorized by the Board of Directors, all of whom shall be elected by the Board of Directors from its own membership for a term of two years, at least one half of them each year, and a Counsel, a Treasurer, and an Executive Secretary who shall be elected by the Directors and who shall hold office a minimum of four calendar years and until their successors have been elected and qualified. Regular Army personnel while on active status shall not be eligible to hold other than an honorary national office in the Association.

SEC. 4. The Board of Directors shall have charge of the affairs of the Association and shall consist of the immediate past president, the president (who shall be ex officio chairman), the vice presidents and 16 other members elected by the Council. The term of office of members of the Board of Directors shall be for four calendar years, provided that initially the term of five members thereof shall be for two years, five others for three years and the remaining ones for the full four years, and every four years thereafter. The Board of Directors shall have the power to fill casual vacancies in the case of its members and in the offices of President and Vice Presidents. The Board shall meet at least once each year, five members constituting a quorum.

SEC. 5. The Executive Committee shall consist of the President and two senior Vice Presidents and one Director to be appointed annually by the Board of Directors and shall have power to take ad interim action, subject to approval by the Board at its next subsequent meeting, upon all questions which require action by the Board. It shall have such other duties as prescribed by this Constitution and the By-Laws of the Association. The Executive Secretary, the Treasurer and Counsel shall be ex officio members of the Executive committee.

SEC. 6. The Board of Directors shall have power to make By-Laws for the government of the Association and to alter, change, or amend the same.

ARTICLE IV

MEETINGS

SEC. 1. The Association shall hold an annual meeting in the spring of the year at a time and place to be designated by the Executive Committee. The purpose of the meeting shall be in conformance with the objectives of the Association and for each meeting the Executive Committee will prepare a program to include where possible the demonstration of such military communications and photographic equipment and training as may be authorized by proper authority. There may also be meetings devoted to discussions of scientific, industrial and military experience, related to preparedness and national security.

SEC. 2. The Association may hold such special meetings as may be necessary, to be called in the manner provided by the By-Laws.

ARTICLE V

CORPORATE OBLIGATIONS

SEC. 1. No obligation shall be incurred on behalf of the Association except by the Executive Secretary and by him only to the extent of funds in the Treasury available to meet the obligation. When and if the Association is incorporated all obligations incurred by the Corporation shall be solely corporate obligations and no personal liability whatsoever shall attach to, or be incurred by, any member, officer, or director of this Corporation by reason of any such corporate obligations.

ARTICLE VI

AMENDMENTS

SEC. 1. Amendments to this Constitution may be proposed by a majority vote of the Board of Directors or of the Executive Committee or upon petition addressed to the President and signed by not less than five (5) per cent of the total number of full members.

SEC. 2. Proposed amendments shall be submitted to the entire active full membership by letter ballot and shall be adopted if a majority of the votes cast are in favor thereof.

SEC. 3. Voting shall cease and the polls close on amendments to the Constitution on a predetermined date not less than thirty (30) days after the ballots have been mailed to the members. The votes shall be counted by a committee of three tellers appointed by the President and certified to the Executive Secretary within fifteen (15) days after the polls have closed.

SEC. 4. Amendments, unless otherwise provided for, shall become effective upon receipt by the Executive Secretary of a certificate of their adoption by the tellers.

BY-LAWS

AIMS AND PURPOSES

1. The aims and purposes of the Association shall be:

(a) To maintain closer relations than ever before between civilian scientists, engineers, manufacturers and operating companies and those concerned with similar activities in military communications and photography.

(b) To preserve and foster the spirit of fellowship among former, present, and future communications personnel of the armed forces, commissioned, enlisted and civilian.

(c) To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace.

(d) To educate the public at large and keep its members informed of requirements in the field of military communications and photography.

(e) To promote mutual understanding and to effect cooperation between American scientists, inventors, engineers, and manufacturers in civil life and the Regular Army, National Guard, Reserve personnel, and units and teams of the Army and Army Air Forces concerned with communications preparedness.

(f) To commemorate the services rendered by the industry of the nation and by the officers, enlisted men, and civilian employees of military communications and photography and of American science and industry in the wars in which the United States has been or may hereafter be engaged.

(g) To encourage programs for photo and communication equipment research and development particularly among private industrial, educational and research organizations in cooperation with the research agencies of the Army and Air Forces and all other components of the armed forces and to keep available the highest specialized knowledge necessary for arming the nation by stimulating interest in the design and production of photographic and communication equipment.

(h) To encourage adequate military training throughout the nation and the upbuilding of adequate enlisted and commissioned reserves.

(i) To maintain as a contribution to industrial preparedness the splendid liaison and cooperation that existed between the Army, the Army Air Forces, and the communications, electronics, motion picture, and photographic industries during the war.

(j) To assist in developing and maintaining an efficient personnel, commissioned, enlisted, and civilian for the supply (including design and development), installation, maintenance, and operation of communication, electronic, motion picture, and photographic equipment in the field in an emergency.

CLASSES OF MEMBERSHIP

2. FULL MEMBERSHIP in the Association shall be open to all American citizens interested in advancing the aims of the Association and in any phase of national defense—especially in communications and photographic phases thereof. Present and former officers, enlisted men and women and civilian employees in photography and communications, whether in the Air Forces, Ground Forces or Signal Corps, shall be especially encouraged to become full members.

3. LIFE MEMBERSHIP in the Association shall be open to all men and women who are American citizens and who are interested in promoting the objectives of the Association. Life membership shall continue during the lifetime of the life member and shall expire at death. It shall not be transferable.

4. STUDENT OR ASSOCIATE MEMBERSHIP in the Association shall be open to all men and women who are American citizens and who are students in schools and colleges and to present or former enlisted members of the Armed Forces who are not full members. These members shall not vote or hold office in the Association.

5. GROUP MEMBERSHIP in the Association shall be open to all firms, companies, and groups controlled by American citizens who are interested in promoting the cause of industrial preparedness particularly in connection with research, development, production, manufacture, operation, and supply of communication and photographic equipment for the Armed Forces of the United States. Group members shall have the privilege of nominating five of their employees or officials who are American citizens for full membership in the Association and members thus nominated shall pay no dues.

6. HONORARY MEMBERSHIP shall be proposed by at least ten full or life members of the Association and the unanimous vote of the Board of Directors shall be necessary for an election. Honorary members shall be entitled to all privileges of full membership except as otherwise provided in this constitution and in the by-laws.

7. The term "member" except where specifically stated otherwise in this constitution and in the by-laws shall mean full and life members only. Only these may vote or hold office.

8. The election to membership of all classes shall be entrusted to the Executive Committee, and the decision of that Committee as to eligibility shall be final.

9. Any person desiring to become a member shall make written application to the Executive Secretary. Said application shall be in such form and contain such data as may be prescribed by the Executive Committee. Said application may be acted upon by the Executive Secretary or the Membership Committee, in either case subject to subsequent approval by the Executive Committee.

10. Any member may withdraw from the Association at any time by tendering his resignation in writing, but such resignation shall not become effective until said member shall have paid all obligations due the Association from him at the time of such resignation.

11. Any member may be dropped for cause by a vote of three members of the Executive Committee, or having been dropped may be reinstated at the discretion of the Executive Committee.

12. All members are entitled to receive one copy of the Association publications for which $3.00 of the annual dues are charged—except that the entire $2.00 of student dues is for the publications.

MEMBERSHIP DUES

13. The fee for life membership in the Association shall be fifty dollars ($50.00). The annual dues for membership in the Association shall be, for full members, four dollars ($4.00); for student members, two dollars ($2.00); and for group members, one hundred dollars ($100.00), plus an additional amount of four dollars ($4.00) for each individual member nominated by the Company member in excess of five, all payable in advance. These sums

are in addition to whatever dues or assessments may be imposed by the respective local chapters in the case of members, who join the local chapter in the territory in which they reside.

a. Local chapters may collect whatever local dues may be assessed against their members. They may raise additional fund for local activities by subscription, voluntary contributions or other appropriate means. Annual dues to the Association shall be collected by the Association in the usual manner.

OFFICERS

14. The President shall have general supervision of the affairs of the Association and shall perform the duties usual to his office. He shall preside at the meetings of the Association, of the Board of Directors, and of the Executive Committee. He shall be ex officio a member of all committees and of all subcommittees thereof. In the absence of the President his duties shall devolve upon the Vice Presidents in order of seniority of service in the Association.

15. The first vice president shall have general charge of memberships and the activities of local chapters and shall be charged with the responsibility of fostering their success.

16. The second vice president shall have general charge of the activities of the National Advisory Committees. ... ...

17. The counsel shall be the legal adviser to the officers, the Executive Committee and the Board of Directors.

18. The Treasurer shall be comptroller of the finances and accounts of the Association under the direction of the Executive Committee. He shall render an annual report and such special reports as may be called for by the Executive Committee. The accounts of the Association shall be audited annually by independent auditors. However, in the discretion of the Executive Committee a certified public accountant may conduct the annual audit, his report to be made to the Executive Committee.

19. The fiscal year shall close on June 30 of each year.

20. The Executive Secretary shall make collections and disbursements under the supervision of the Executive Committee, shall keep the roster of the members and the records of the status of annual dues, shall be the keeper of the seal of the Association and shall have custody of correspondence and records. He shall be responsible that suitable arrangements are made for the annual and other meetings of the Association, of the Council, of the Board of Directors, and of the Executive Committee, the proceedings of which he shall record. He shall submit an annual report to the Executive Committee for presentation to the Board of Directors at its annual meeting. He shall be responsible for the management of the executive offices and shall have the power to contract in the name of the Association for such services and supplies as are necessary for its operation. He shall have administrative charge of the activities and programs of the Association, of National Headquarters and all Association publications.

CHAPTERS

21. Upon petition signed by not less than twenty-five (25) members of the Association in any locality, stating their desire to form a local unit for the more intimate achievement of the purposes of the Association, such unit to be known as a local chapter, the Executive Secretary of the Association shall immediately authorize a meeting for such inauguration and the Association shall contribute to the organizing expenses of such chapter the sum of one dollar ($1.00) for each such petitioner, such payment to be, however, not over fifty dollars ($50.00) in the aggregate. Generally, a credit in this amount will be set up at National Headquarters against which the local chapter may submit bills for payment.

22. When not less than twenty-five (25) members of the Army Signal Association shall have enrolled as members of such Chapter, the Association shall issue a suitable charter thereto, signed by the President and Executive Secretary of the Association.

23. Every member of the Association may also be a member of the local chapter of the territory in which he resides, but no one shall be a member of a local chapter who is not a member of the Association. The local chapter may collect annually whatever local dues may be assessed against its actual members. The sum of twenty-five cents ($.25) shall be remitted or established as a credit at National Headquarters to each local chapter for each of its full members upon the payment by them of their annual renewal dues to the Association. This amount shall be increased to fifty cents ($.50) for full members and ten dollars ($10.00) for life and group members when the total full membership of the Association exceeds ten thousand (10,000), additional remittances may be given to local chapters from time to time when authorized by the Executive Committee, if the financial condition of the Association permits.

24. The Constitution of each local chapter shall be in the general form of that of the Association and shall be submitted to the Executive Secretary of the Association and shall be approved by him before the same shall become effective.

25. It shall be the general purpose of the chapters to cultivate a more intimate understanding of military photographic and communications subjects through meetings, laboratory and plant visits, seminars and reports on special problems. Local authority shall be a guiding principle consistent with the national objectives and policies of the Association. Chapters may organize such sub-chapters or posts in their zones as local interest may justify.

RESTRICTIONS

26. No officer or enlisted man on the active list of the Army or Navy shall be employed by the Association in any paid capacity, but this shall not prohibit the acceptance of articles for pay from officers and enlisted men for publication, nor their service as officers of local chapters.

NOMINATIONS AND ELECTIONS

27. The Council on or before February 1st of each year in which elections are to be held, shall deliver to the Executive Secretary in writing, the names of its nominees for the Board of Directors to fill vacancies which will exist on the date of the election. The Executive Secretary shall communicate with each nominee. In the case of the declination of any nominee to accept his nomination, the Executive Secretary will report the fact of such declination to the Council which will then nominate another member for the office. The Council shall meet at the call of its Chairman not later than May 1st to complete the election of directors to replace those whose terms expire. The Executive Secretary shall notify the Chairman of the Council thirty (30) days before the expiration of the term of any director. The Council Chairman may make interim appointments to fill unexpected vacancies.

AMENDMENTS

28. The Board of Directors by majority vote of those present at a meeting may make amendments to these by-laws.

INSIGNIA

29. The insignia or emblem of the Association shall consist of:

a. The central figure is an alert powerful American eagle with strong talons clutching lightning flashes—symbolic of a strong America insofar as national defense and especially modern communications are concerned—our basic reason for existence. The border consists of leaves of the olive branch of peace, showing that the object of military preparedness in America is to assure a lasting peace. In the background are signal flags—the first means of signaling in the U. S. Signal Corps and a method still used for special purposes in the armed forces. Just above the eagle and between his outstretched wings, is a heavy bomber in flight, symbolizing the complicated and essential communications in the Air Forces, both intra- and inter-aircraft, air-ground, and on the ground. Above that is a radar antenna array and at the very top a radio relay antenna—for the latest major step in military communications. In the color version there are the traditional colors of the signal flags—dexter white flag with red center and sinister red flag with white center—with a gold border to the whole.

b. Insignia in this form with ribbon and modifications of it in the form of pins, badges, buttons and rings, shall be authorized by the Board of Directors for use of members. The ribbon shall be the colors of the rainbow—a combination of the colors of all arms and services everyone of which is concerned with the use or operation of communications and photography.

30. The flag of the Association shall be the above insigne superimposed upon a field of orange cloth. Under the insigne shall be a scroll on which shall be inscribed "National Security through Military Preparedness."

NATIONAL ADVISORY COMMITTEE

31. Members of the Association shall be eligible for membership on National Advisory Committees. These committees are in addition to local chapters and shall be devoted primarily to the advancement of knowledge, engineering practices and production and design techniques relating to special fields of communications or photography and to activities of the Association.

32. These Committees shall be organized in conformity with conditions in each particular field rather than according to any standard pattern.

33. Each committee shall have a Chairman selected by the Board of Directors. The other members shall be designated by the Chairman. Through meetings, conferences and discussions and in cooperation with local chapters they shall keep the membership in close contact with progress and developments in their special fields. They shall meet as committees from time to time to initiate recommendations or reports and shall be available in an advisory capacity on such matters as may be presented for their study and report either by the armed forces or the Association.

A device for retaining body heat exhaled with the breath in extremely cold climates is being tested by Army Ground Forces Task Force· "Frigid" at Fairbanks, Alaska and also in the Antarctic, the War Department has recently announced.

Known as the heat regenerating respirator, this Quartermaster-designed equipment demonstrated a high degree of efficiency in tests conducted under sub-zero temperatures in weather chambers at the Quartermaster Climatic Research Laboratory at Lawrence, Massachusetts.

Made of soft rubber, light and simple in construction, the respirator fits snugly about the nose and mouth and is worn partly within and partly outside the arctic face mask. The portion within the mask is held in place by the pressure of the mask. The section outside the mask consists of a cylindrical tube which is filled with metal wool made of copper or stainless steel.

The metal wool absorbs the heat contained in the vapor expired by the breath and releases this heat to the inspired air. In this way, the upper respiratory tract and lungs of the wearer are protected against extremely cold air and body heat is conserved.

All-weather flying and speedier operation along United States airways are now possible as a result of a joint experimental and research project to test landing aids under adverse weather conditions conducted by Army Air Forces and the Navy Bureau of Aeronautics, in cooperation with the Civil Aeronautics Administration.

The first phase of the program was recently completed at the Landing Aids Experiment Station, Arcata, California, with tests being made on all the latest types of landing aid equipment available. The experiments indicated that the most reliable method for landing aircraft under conditions of low visibility would involve the use of three different landing aids. These aids include either the Instrument Landing System or the Ground Control Approach as the backbone of the integrated system; a system of high intensity approach and runway lights to aid in establishing visual contact with the runway; and high pressure fog dispersal equipment to insure visual contact with the runway under heavy fog conditions.

CHANGES IN KEY PERSONNEL

UNDER ORDERS TO RETIRE:

Brig. Gen. Edgar L. Clewell, effective 30 Nov. 1946 (Disability)
Colonel Haskell Allison, effective 31 Oct. 1946 (Disability)
Colonel Hugh C. Dorrien, effective 31 Oct. 1946 (Disability)
Colonel John J. Downing, effective 31 Dec. 1946
Colonel Samuel S. Lamb, effective 30 Nov. 1946 (Disability)
Colonel William A. Marsh, effective 30 Nov. 1946
Colonel Leon E. Ryder, effective 30 Nov. 1946 (Disability)
Colonel Robert M. Shaw, effective 31 Dec. 1946 (Disability)
Colonel Kenneth S. Stice, effective 30 Nov. 1946 (Disability)
Colonel William E. Talbot, effective 30 Nov. 1946 (Disability)
Colonel Herbert G. Messer, effective 31 Dec. 1946 (Disability)
Colonel Harold J. Adams, effective 31 Jan. 1947 (Disability)
Colonel Frank W. Bullock, effective 28 Feb. 1947

ASSIGNMENTS TO THE OFFICE OF THE CHIEF SIGNAL OFFICER:

Colonel Marion Van Voorst, Procurement and Distribution Service
Colonel George F. Wooley, Procurement and Distribution Service.
Colonel Murray D. Harris, Executive Office

INSTALLATIONS UNDER JURISDICTION OF THE CHIEF SIGNAL OFFICER:

Colonel Robert E. Burns, Signal Corps Photo Center, L.I.C., N. Y.
Colonel Harrod G. Miller, Commandant, Sig. Supply Sch., Holabird Depot
Colonel G. L. Richon, Hq., Ft. Monmouth, Staff & Faculty, Sig. C. Sch.

ASSIGNMENTS TO GROUND FORCE UNITS:

Colonel Louis S. Stickney, Replacement Training Center, Ft. Dix, N. J.
Colonel Allen L. Stowell, 2nd Army, station Instructor, Ohio Nat. Guard
Colonel Alfred H. Anderson, Hq., V Corps, Ft. Bragg, N. C.
Colonel Chester A. Carlsten, Armored School, Ft. Knox, Kentucky
Colonel Richard B. Moran, Hq., Fourth Army, Ft. Sam Houston, Texas

OVERSEAS ASSIGNMENTS:

Colonel Harry L. Vitzthum, AFPAC, Korea
Colonel Carl H. Hatch, AFMIDPAC, Hawaii
Colonel Airel B. Cooper, Marianas-Bonin Command, Guam, Marianas
Colonel Joseph J. Miller, Hawaii
Brig. Gen. George I. Back, Hq., U. S. Forces Far East Comd., Tokyo, Japan

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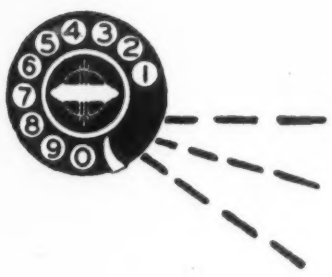
NEW REGULAR ARMY OFFICERS

The following officers have accepted permanent commissions in the Signal Corps, Regular Army:

Capt. Jack A. Albright—1st Lt.
Maj. Woodrow W. Anderson—1st Lt.
Capt. Donald A. Beyer—1st Lt.
Lt. Col. Thomas S. Bond, Jr.—1st Lt.
Major Maskell E. Brown—Capt.
Lt. Col. Harold A. Buck—Major
Lt. Col. Gerald Carlisle—1st Lt.
1st Lt. Alvin M. Churchwell—1st Lt.
Maj. Carroll M: Covington—Capt.
Maj. Hollis Dakin—1st Lt.
Capt. Dan R. Davis—1st Lt.
Capt. Ottis A. Davis—1st Lt.
Lt. Col. Robert S. Drake—Capt.
Capt. Harry V. Drinkard—1st Lt.
Maj. Russell A. Duke—1st Lt.
1st Lt. Williard Flint—1st Lt.
Maj. Norman Gray—1st Lt.
Capt. George E. Green—1st Lt.
1st Lt. John P. Hastings—1st Lt.
1st Lt. Robert L. Hayes—1st Lt.
Capt. Richard C. Horne, III—1st Lt.
Maj. Horace L. Jennerson—Maj.
Maj. Finis G. Johnson—Capt.
Lt. Col. George V. Johnson—Capt.
Maj. Henry A. Keller—Maj.
Capt. Gerald L. Kerr, Jr.—1st Lt.
Maj. Royall R. Mauzy—Capt.
Capt. William S. Milliken—1st Lt.
Maj. Philmore L. Moen—Capt.
Capt. Edward L. Nielsen—1st Lt.
Maj. James B. Nixdorff—1st Lt.
Capt. Emanuel P. Peters—1st Lt.
Lt. Col. Morton A. Rubin—Capt.
Capt. Henry H. Sablitz—1st Lt.
Capt. Frank G. Sheviak—1st Lt.
Capt. Robert W. Strunk—1st Lt.
Capt. Walter C. Stubbs, Jr.—1st Lt.
Maj. Hugh A. Vest—Capt.
Capt. Charles A. Webb, Jr.—1st Lt.
Capt. Albert E. Zellefrow—1st Lt.
Capt. James S. Branch—1st Lt.
Lt. Col. James E. Dupree—Capt.
Capt. Irving Koss—1st Lt.
Capt. Charles A. Vitarius—1st Lt.

The battleship Kentucky and the battlecruiser Hawaii, now being built, respectively, at the Norfolk Naval Shipyard and the New York Shipbuilding Corporation at Camden, N. J., are to be armed with main batteries of guided missiles instead of guns. The 45,000-ton Kentucky begun in 1944, is 70% completed. The 27,000-ton Hawaii, started in 1943, is 85% complete.



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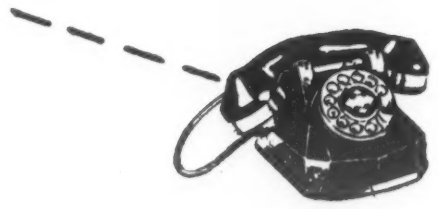

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"Snooperscope"--sees at night with invisible light!

Crime detection is one of the many uses for this uncanny telescope that can distinguish objects more than several hundred yards away in a complete blackout.

The sniperscope and snooperscope are two wartime developments of RCA Laboratories in co-operation with the U. S. Army which are now being converted to civilian, industrial and police uses.

These instruments were made possible through a tiny image tube less than two inches in diameter and less than five inches long. Adapted to various military equipment, these telescopes provided the Army with some of its best night-fighting devices. A helmet-mounted binocular employing these image tubes enabled scout cars to speed over roads at 40 to 50 miles an hour without lights.

The same engineering skill that produced the snooperscope is reflected in every RCA and RCA Victor product—whether it is a Victrola* radio-phonograph, made exclusively by RCA Victor, or a television receiver, or a radio tube. If it's an RCA, it is one of the finest instruments of its kind science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 2:00 P. M., Eastern Standard Time, over NBC Network.

The "Sniperscope." Here our infrared telescope is mounted on a carbine. The combination was aptly called a "sniperscope" for it enabled a soldier in total darkness to hit a target the size of a man at 75 yards. Thirty per cent of the Japanese casualties during the first three weeks of the Okinawa campaign were attributed by the Army to this amazing sniperscope.

RCA RADIO CORPORATION of AMERICA

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Output	7.78 μμf
Maximum Ratings	
D-C Plate Voltage	6000 max. volts
D-C Plate Current	700 max. ma.
Plate Dissipation	750 max. watts

Here's a new Eimac tetrode—the power step-up you have been asking to have added to the Eimac line.

Capable of 2-kw power output at 4000 plate volts, with less than 15 watts of grid drive, the 4-750A opens a new field of possibilities to designers of electronic equipment. A pair of these tetrodes, driven by low cost, low-power tubes, will supply more than 4-kw output.

A potential workhorse for communications and industrial use, the 4-750A has the ability to deliver its maximum power over a wide range of frequencies. Inherent characteristics include the familiar attributes of Eimac tetrodes—stability, economy, and dependability.

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